BALDOR

MotiFlex® e100

Servo Drive

Installation manual

MN1943 1/11

Contents

1 General Information 1-1

2 Introduction 2-1

2.1 MotiFlex *e*100 features 2-1

2.2 Receiving and inspection 2-2
2.2.1 Identifying the catalog number 2-2

2.3 Units and abbreviations 2-3

2.4 Standards 2-4
2.4.1 Design and test standards 2-4
2.4.2 Environmental test standards: 2-4
2.4.3 Marks 2-4

3 Basic Installation 3-1

3.1 Introduction 3-1
3.1.1 Power sources 3-1
3.1.2 Hardware requirements 3-1
3.1.3 Tools and miscellaneous hardware 3-2
3.1.4 Other information needed for installation 3-2

3.2 Mechanical installation 3-3
3.2.1 Dimensions - 1.5 A ~ 16 A models 3-4
3.2.2 Dimensions - 21 A ~ 33.5 A models 3-5
3.2.3 Dimensions - 48 A ~ 65 A models 3-6
3.2.4 Mounting the MotiFlex *e*100 3-7
3.2.5 Overtemperature trips and intelligent fan control 3-10

3.3 Connector locations 3-11
3.3.1 Front panel connectors 3-11
3.3.2 Top panel connectors 3-12
3.3.3 Bottom panel connectors 3-13

3.4 AC power connections 3-14
3.4.1 Earthing / grounding 3-14
3.4.2 AC input and regeneration resistor output wiring 3-15
3.4.3 Earth leakage 3-16
3.4.4 AC power connections 3-17
3.4.5 AC power cycling 3-18
3.4.6 Inrush current 3-18
3.4.7 Phase loss detection 3-18
3.4.8 Drive overload protection 3-18
3.4.9 Input power conditioning 3-19
3.4.10 Power supply filters 3-20
3.4.11 Power disconnect and protection devices 3-21
3.4.12 Recommended wire sizes 3-22

3.5 Sharing the DC bus 3-23
3.5.1 DC busbar connection 3-23
3.5.2 'Power ready' input / output 3-24
3.5.3 Line reactors 3-25

3.6 18 VDC out / 24 VDC in control circuit backup supply 3-26
3.6.1 24 VDC backup supply 3-26
3.6.2 24 VDC control circuit backup supply wiring 3-27

3.7 Motor connections 3-28
3.7.1 Motor cable shielding 3-30
3.7.2 Motor circuit contactor 3-31
3.7.3 Sinusoidal filter 3-31
3.7.4 Motor power cable pin configuration - Baldor BSM rotary motors 3-32
3.7.5 Motor cable pin configuration - Baldor linear motors 3-33
3.7.6 Motor brake connection 3-34
3.7.7 Motor overtemperature input 3-35
3.7.8 Bottom panel wiring 3-35

3.8 Regeneration resistor (Dynamic Brake resistor) 3-36
3.8.1 Regeneration capacity 3-37

3.9 Regeneration resistor selection 3-38
3.9.1 Required information 3-38
3.9.2 Regenerative energy 3-39
3.9.3 Regenerative power and average power 3-39
3.9.4 Resistor choice 3-40
3.9.5 Resistor temperature derating 3-41
3.9.6 Resistor pulse load rating 3-42
3.9.7 Duty cycle 3-43

4 Feedback 4-1

4.1 Introduction 4-1
4.1.1 Incremental encoder interface 4-2
4.1.2 BiSS interface 4-7
4.1.3 SSI interface 4-9
4.1.4 SinCos interface 4-11
4.1.5 EnDat interface 4-13

5 Input / Output 5-1

5.1 Introduction 5-1

5.2 Analog I/O 5-2
5.2.1 Analog input - X3 (demand) 5-2

5.3 Digital I/O 5-4
5.3.1 Drive enable input 5-5
5.3.2 General purpose digital input DIN0 5-7
5.3.3 General purpose digital inputs DIN1 & DIN2 5-9
5.3.4 Special functions on inputs DIN1 & DIN2 5-10
5.3.5 Motor overtemperature input 5-12

5.3.6 General purpose / status digital output DOUT0 5-14
5.3.7 General purpose digital output DOUT1 5-16

5.4 USB interface 5-17
5.4.1 USB 5-17

5.5 RS485 interface 5-18
5.5.1 RS485 (2-wire) 5-18

5.6 Ethernet interface 5-19
5.6.1 TCP/IP 5-19
5.6.2 Ethernet POWERLINK 5-20
5.6.3 Ethernet connectors 5-21

5.7 CAN interface 5-22
5.7.1 CAN connector 5-22
5.7.2 CAN wiring 5-22
5.7.3 CANopen 5-24

5.8 Other I/O 5-25
5.8.1 Node ID selector switches 5-25

6 Configuration 6-1

6.1 Introduction 6-1
6.1.1 Connecting the MotiFlex *e*100 to the PC 6-1
6.1.2 Installing Mint Machine Center and Mint WorkBench 6-1

6.2 Starting the MotiFlex *e*100 6-2
6.2.1 Preliminary checks 6-2
6.2.2 Power on checks 6-2
6.2.3 Installing the USB driver 6-3
6.2.4 Configuring the TCP/IP connection (optional) 6-4

6.3 Mint Machine Center 6-5
6.3.1 Starting MMC 6-7

6.4 Mint WorkBench 6-8
6.4.1 Help file 6-9
6.4.2 Starting Mint WorkBench 6-10
6.4.3 Commissioning Wizard 6-12
6.4.4 Using the Commissioning Wizard 6-13
6.4.5 Autotune Wizard 6-15
6.4.6 Further tuning - no load attached 6-16
6.4.7 Further tuning - with load attached 6-18
6.4.8 Optimizing the velocity response 6-19
6.4.9 Performing test moves - continuous jog 6-22
6.4.10 Performing test moves - relative positional move 6-23

6.5 Further configuration 6-24
6.5.1 Parameters tool 6-24
6.5.2 Spy window 6-25
6.5.3 Other tools and windows 6-26

7 Troubleshooting 7-1

7.1 Introduction 7-1
7.1.1 Problem diagnosis 7-1
7.1.2 SupportMe feature 7-1
7.1.3 Power-cycling the MotiFlex *e*100 7-1

7.2 MotiFlex *e*100 indicators 7-2
7.2.1 STATUS LED 7-2
7.2.2 CAN LEDs 7-3
7.2.3 ETHERNET LEDs 7-4
7.2.4 Communication 7-5
7.2.5 Power on 7-5
7.2.6 Mint WorkBench 7-5
7.2.7 Tuning 7-6
7.2.8 Ethernet 7-6
7.2.9 CANopen 7-6

8 Specifications 8-1

8.1 Introduction 8-1

8.2 AC input 8-1
8.2.1 AC input voltage (X1) - all models 8-1
8.2.2 AC input current (X1), DC bus not shared - all models 8-2
8.2.3 AC input current (X1), DC bus sharing - all models 8-4
8.2.4 Recommended fuses and circuit breakers when sharing the DC bus 8-8
8.2.5 Power, power factor and crest factor - 1.5 A ~ 16 A models 8-9
8.2.6 Power, power factor and crest factor - 21 A model 8-12
8.2.7 Power, power factor and crest factor - 26 A & 33.5 A models 8-13
8.2.8 Power, power factor and crest factor - 48 A & 65 A models 8-14

8.3 Motor output 8-15
8.3.1 Motor output power (X1) - 1.5 A ~ 16 A models 8-15
8.3.2 Motor output power (X1) - 21A ~ 33.5 A models 8-15
8.3.3 Motor output power (X1) - 48 A ~ 65 A models 8-16
8.3.4 Motor output uprating and derating 8-17
8.3.5 Motor output rating adjustment - 1.5 A model 8-17
8.3.6 Motor output rating adjustment - 3 A model 8-18
8.3.7 Motor output rating adjustment - 6 A model 8-19
8.3.8 Motor output rating adjustment - 10.5 A model 8-20
8.3.9 Motor output rating adjustment - 16 A model 8-21
8.3.10 Motor output rating adjustment - 21 A model 8-22
8.3.11 Motor output rating adjustment - 26 A model 8-23
8.3.12 Motor output rating adjustment - 33.5 A model 8-24
8.3.13 Motor output rating adjustment - 48 A model 8-25
8.3.14 Motor output rating adjustment - 65 A model 8-26

8.4 Regeneration 8-27
8.4.1 Regeneration (X1) - 1.5 A ~ 16 A models 8-27
8.4.2 Regeneration (X1) - 21 A ~ 33.5 A models 8-27
8.4.3 Regeneration (X1) - 48 A ~ 65 A models 8-28

8.5 18 VDC output / 24 VDC input 8-29
8.5.1 18 VDC output / 24 VDC control circuit backup supply input (X2) 8-29
8.5.2 Option card power supply 8-29
8.6 Input / output 8-31
8.6.1 Analog input - AIN0 (X3) 8-31
8.6.2 Digital inputs - drive enable and DIN0 general purpose (X3) 8-31
8.6.3 Digital inputs DIN1, DIN2 - high speed general purpose (X3) 8-31
8.6.4 Digital outputs DOUT0, DOUT1 - status and general purpose (X3) 8-32
8.6.5 Incremental encoder interface (X8) 8-32
8.6.6 SSI interface (X8) 8-32
8.6.7 BiSS interface (X8) 8-32
8.6.8 SinCos / EnDat interface (X8) 8-33
8.6.9 Ethernet interface 8-33
8.6.10 CAN interface 8-33
8.6.11 RS485 interface (X6) 8-34
8.7 Weights and dimensions 8-34
8.7.1 Weights and dimensions - 1.5 A ~ 16 A models 8-34
8.7.2 Weights and dimensions - 21 A ~ 33.5 A models 8-34
8.7.3 Weights and dimensions - 48 A ~ 65 A models 8-34
8.8 Environmental 8-35

Appendices

A Accessories A-1
A.1 Introduction A-1
A.1.1 Busbars for DC bus sharing A-2
A.1.2 AC supply (EMC) filters A-3
A.1.3 AC line reactors A-4
A.1.4 Regeneration resistors A-5
A.1.5 Motor / power cable management bracket A-7
A.1.6 Signal cable management bracket A-8
A.2 Cables A-9
A.2.1 Motor power cables A-9
A.2.2 Feedback cable part numbers A-10
A.2.3 Ethernet cables A-10
B Control System B-1
B.1 Introduction B-1
B.1.1 Servo configuration B-2
B.1.2 Torque servo configuration B-4

C Mint Keyword Summary C-1
C.1 Introduction C-1
C.1.1 Keyword listing C-1

D CE & UL D-1
D.1 Introduction D-1
D.1.1 CE marking D-1
D.1.2 Declaration of conformity D-2
D.1.3 Use of CE compliant components D-3
D.1.4 EMC wiring technique D-3
D.1.5 EMC installation suggestions D-4
D.1.6 Wiring of shielded (screened) cables D-5
D.2 UL file numbers D-6

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MotiFlex *e*100 is UL listed; file NMMS.E128059.

Limited Warranty
For a period of two (2) years from the date of original purchase, Baldor will repair or replace without charge controls and accessories that our examination proves to be defective in material or workmanship. This warranty is valid if the unit has not been tampered with by unauthorized persons, misused, abused, or improperly installed and has been used in accordance with the instructions and/or ratings supplied. This warranty is in lieu of any other warranty or guarantee expressed or implied. Baldor shall not be held responsible for any expense (including installation and removal), inconvenience, or consequential damage, including injury to any person or property caused by items of our manufacture or sale. (Some countries and U.S. states do not allow exclusion or limitation of incidental or consequential damages, so the above exclusion may not apply.) In any event, Baldor's total liability, under all circumstances, shall not exceed the full purchase price of the control. Claims for purchase price refunds, repairs, or replacements must be referred to Baldor with all pertinent data as to the defect, the date purchased, the task performed by the control, and the problem encountered. No liability is assumed for expendable items such as fuses. Goods may be returned only with written notification including a Baldor Return Authorization Number and any return shipments must be prepaid.

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Product notice

Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.
This equipment may be connected to other machines that have rotating parts or parts that are controlled by this equipment. Improper use can cause serious or fatal injury.

Safety Notice

Intended use: These drives are intended for use in stationary ground based applications in industrial power installations according to the standards EN60204 and VDE0160. They are designed for machine applications that require variable speed controlled three-phase brushless AC motors. These drives are not intended for use in applications such as:

- Home appliances
- Medical instrumentation
- Mobile vehicles
- Ships
- Airplanes.

Unless otherwise specified, this equipment is intended for installation in a suitable enclosure. The enclosure must protect the equipment from exposure to excessive or corrosive moisture, dust and dirt or abnormal ambient temperatures. The exact operating specifications are found in section 3 and section 8 of this manual. The installation, connection and control of drives is a skilled operation. This equipment contains no user-serviceable parts; disassembly or repair must not be attempted. In the event that the equipment fails to operate correctly, contact the place of purchase for return instructions.

Precautions

DANGER

Do not touch any circuit board, power device or electrical connection before you first ensure that no high voltage is present at this equipment or other equipment to which it is connected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt to start-up, program or troubleshoot this equipment.

DANGER

The motor circuit might have high voltages present whenever AC power is applied, even when the motor is not moving. Electrical shock can cause serious or fatal injury.

DANGER

After AC power has been removed from the MotiFlex *e*100, high voltages (greater than 50 VDC) can remain on power connections for up to 5 minutes, while the DC bus circuitry discharges. Do not touch the DC bus, regeneration resistor, or other power connections during this period.

DANGER

If a motor is driven mechanically, it might generate hazardous voltages that are conducted to its power terminals. The enclosure must be earthed/grounded to prevent possible shock hazard.

DANGER

Be sure the system is properly earthed/grounded before applying power. Do not apply AC power before you ensure that earths/grounds are connected. Electrical shock can cause serious or fatal injury.

WARNING

Be sure that you are completely familiar with the safe operation and programming of this equipment. This equipment may be connected to other machines that have rotating parts or parts that are controlled by this equipment. Improper use can cause serious or fatal injury.

MEDICAL DEVICE / PACEMAKER DANGER: Magnetic and electromagnetic fields in the vicinity of current carrying conductors and industrial motors can result in a serious health hazard to persons with cardiac pacemakers, internal cardiac defibrillators, neurostimulators, metal implants, cochlear implants, hearing aids, and other medical devices. To avoid risk, stay away from the area surrounding a motor and its current carrying conductors.

Be sure all wiring complies with the National Electrical Code and all regional and local codes. Improper wiring may result in unsafe conditions.

The stop input to this equipment should not be used as the single means of achieving a safety critical stop. Drive disable, motor disconnect, motor brake and other means should be used as appropriate.

Improper operation or programming of the drive may cause violent motion of the motor and driven equipment. Be certain that unexpected motor movement will not cause injury to personnel or damage to equipment. Peak torque of several times the rated motor torque can occur during control failure.

If the drive enable signal is already present when power is applied to the MotiFlex *e*100, the motor could begin to move immediately.

The metal heatsink on the left side of the MotiFlex *e*100 can become very hot during normal operation.

The metal part of the MotiFlex *e*100 case incorporates prominent edges and corners that may cause minor injury if the drive is handled without proper care and attention.

Take care when lifting. The 48 A and 65 A models weigh 12.45 kg (27.4 lb). Seek assistance if necessary. When carrying, do not suspend the unit from the removable front panels as they could detach and cause the unit to be dropped.

When operating a rotary motor with no load coupled to its shaft, remove the shaft key to prevent it flying out when the shaft rotates.

A regeneration resistor may generate enough heat to ignite combustible materials. To avoid fire hazard, keep all combustible materials and flammable vapors away from the brake resistors.

To prevent equipment damage, be certain that the input power has correctly sized protective devices installed.

To prevent equipment damage, be certain that input and output signals are powered and referenced correctly.

To ensure reliable performance of this equipment be certain that all signals to/from the drive are shielded correctly.

Suitable for use on a circuit capable of delivering not more than the RMS symmetrical short circuit amperes listed here, at the rated maximum voltage (480 VAC):

Horsepower	RMS Symmetrical Amperes
1-50	5,000

NOTICE

Avoid locating the drive immediately above or beside heat generating equipment, or directly below water or steam pipes.

NOTICE

Avoid locating the drive in the vicinity of corrosive substances or vapors, metal particles and dust.

NOTICE

Do not connect AC power to the drive terminals U, V and W. Connecting AC power to these terminals may result in damage to the drive.

NOTICE

Baldor does not recommend using “Grounded Leg Delta” transformer power leads that may create earth/ground loops and degrade system performance. Instead, we recommend using a four wire Wye.

NOTICE

Drives are intended to be connected to a permanent main power source, not a portable power source. Suitable fusing and circuit protection devices are required.

NOTICE

The safe integration of the drive into a machine system is the responsibility of the machine designer. Be sure to comply with the local safety requirements at the place where the machine is to be used. In Europe these are the Machinery Directive, the ElectroMagnetic Compatibility Directive and the Low Voltage Directive. In the United States this is the National Electrical code and local codes.

NOTICE

Drives must be installed inside an electrical cabinet that provides environmental control and protection. Installation information for the drive is provided in this manual. Motors and controlling devices that connect to the drive should have specifications compatible to the drive. If not installed in an electrical cabinet, barriers around the equipment are required.

NOTICE

Failure to meet cooling air flow requirements will result in reduced product lifetime and/or drive overtemperature trips.

NOTICE

Violent jamming (stopping) of the motor during operation may damage the motor and drive.

NOTICE

Operating the MotiFlex *e*100 in Torque mode with no load attached to the motor can cause the motor to accelerate rapidly to excessive speed.

NOTICE

Do not tin (solder) exposed wires. Solder contracts over time and may cause loose connections. Use crimp connections where possible.

NOTICE

Electrical components can be damaged by static electricity. Use ESD (electrostatic discharge) procedures when handling this drive.

NOTICE

If the drive is subjected to high potential (‘hipot’) testing, only DC voltages may be applied. AC voltage hipot tests could damage the drive. For further information please contact your local Baldor representative.

NOTICE

Ensure that encoder wires are properly connected. Incorrect installation may result in improper movement.

NOTICE

Removing the cover will invalidate UL certification.

2.1 MotiFlex *e*100 features

The MotiFlex *e*100 is a versatile brushless servo drive, providing a flexible and powerful motion control solution for rotary and linear motors. Standard features include:

- Single axis AC brushless drive.
- Range of models with continuous current ratings of:
  1.5 A, 3 A, 6 A, 10.5 A, 16 A, 21 A, 26 A, 33.5 A, 48 A and 65 A.
- Direct connection to 230 - 480 VAC three-phase supplies.
- Ability to provide power to, or derive power from, a DC busbar connection shared with neighboring drives.
- Universal feedback interface supporting incremental encoder, BiSS, EnDat, SSI or SinCos feedback.
- Position, velocity and current control.
- Auto-tuning wizard (including position loop) and software oscilloscope facilities provided by Mint WorkBench v5.5 configuration software (supplied).
- 3 optically isolated general purpose digital inputs. Two inputs have 'fast input' capability, providing real-time position capture.
- 1 optically isolated drive enable input.
- 1 optically isolated general purpose digital output.
- 1 optically isolated digital output to indicate error conditions.
- 1 motor temperature switch input.
- 1 general purpose ±10 V analog input.
- USB 1.1 serial interface (compatible with USB 2.0).
- CANopen protocol for communication with Mint controllers and other third party CANopen devices.
- Ethernet POWERLINK & TCP/IP support: Twin Ethernet ports with integrated hub for communication with host PC or other Ethernet POWERLINK devices.
- Programmable in Mint.

MotiFlex *e*100 can operate a large range of brushless rotary and linear servo motors. It can also operate induction motors using closed-loop vector control. For information on selecting Baldor motors, please see the sales brochure BR1202 available from your local Baldor representative.

This manual is intended to guide you through the installation of MotiFlex *e*100. The sections should be read in sequence.

The *Basic Installation* section describes the mechanical installation of the MotiFlex *e*100, the power supply connections and motor connections. The other sections require knowledge of the low level input/output requirements of the installation and an understanding of computer software installation. If you are not qualified in these areas you should seek assistance before proceeding.

2.2 Receiving and inspection

When you receive your MotiFlex *e*100, there are several things you should do immediately:

1. Check the condition of the shipping container and report any damage immediately to the carrier that delivered your MotiFlex *e*100.
2. Remove the MotiFlex *e*100 from the shipping container and remove all packing material. The container and packing materials may be retained for future shipment.
3. Verify that the catalog number of the MotiFlex *e*100 you received is the same as the catalog number listed on your purchase order. The catalog number is described in the next section.
4. Inspect the MotiFlex *e*100 for external damage during shipment and report any damage to the carrier that delivered your MotiFlex *e*100.
5. If MotiFlex *e*100 is to be stored for several weeks before use, be sure that it is stored in a location that conforms to the storage humidity and temperature specifications shown in section 8.8.

Note: The 48 A and 65 A MotiFlex *e*100 have a recess at the rear of the product which is filled with a block of packaging foam. Remove this foam before mounting the drive.

2.2.1 Identifying the catalog number

The MotiFlex *e*100 is available with different current ratings. The catalog number is marked on the side of the unit. It is a good idea to look for the catalog number (sometimes shown as ID/No:) and write it in the space provided here:

Catalog number: **MFE**_____

Installed at: _____ **Date:** _____

A description of a catalog number is shown here, using the example **MFE460A003*x***:

	Meaning	**Alternatives**
MFE	MotiFlex *e*100 family	-
460	Requires an AC supply voltage of 230 - 480 Volts, 3Φ	-
A003	Continuous current rating of 3 A	**A001**=1.5 A; **A006**=6 A; **A010**=10.5 A; **A016**=16 A; **A021**=21 A; **A026**=26 A; **A033**=33.5 A; **A048**=48 A; **A065**=65 A
x	A letter indicating the hardware revision. This does not affect the capabilities of the MotiFlex *e*100 unless otherwise stated.	-

2.3 Units and abbreviations

The following units and abbreviations may appear in this manual:

V . . . . . Volt (also VAC and VDC)
W . . . . . Watt
A . . . . . Ampere
Ω . . . . . Ohm
µF . . . . . microfarad
pF . . . . . picofarad
mH . . . . . millihenry

Φ . . . . . phase
ms . . . . . millisecond
µs . . . . . microsecond
ns . . . . . nanosecond

mm . . . . . millimeter
m . . . . . meter
in . . . . . inch
ft . . . . . feet
lbf-in . . . . . pound force inch (torque)
N·m . . . . . Newton meter (torque)

ADC . . . . . Analog to Digital Converter
ASCII . . . . . American Standard Code for Information Interchange
AWG . . . . . American Wire Gauge
CAL . . . . . CAN Application Layer
CAN . . . . . Controller Area Network
CDROM . . . . . Compact Disc Read Only Memory
CiA . . . . . CAN in Automation International Users and Manufacturers Group e.V.
CTRL+E . . . . . on the PC keyboard, press **Ctrl** then **E** at the same time.
DAC . . . . . Digital to Analog Converter
DS301 . . . . . CiA CANopen Application Layer and Communication Profile
DS401 . . . . . CiA Device Profile for Generic I/O Devices
DS402 . . . . . CiA Device Profile for Drives and Motion Control
DS403 . . . . . CiA Device Profile for HMIs
EDS . . . . . Electronic Data Sheet
EMC . . . . . Electromagnetic Compatibility
EPL . . . . . Ethernet POWERLINK
HMI . . . . . Human Machine Interface
ISO . . . . . International Standards Organization
Kbit/s . . . . . kilobits per second
LCD . . . . . Liquid Crystal Display
Mbit/s . . . . . megabits per second
MB . . . . . megabytes
MMC . . . . . Mint Machine Center
(NC) . . . . . Not Connected
RF . . . . . Radio Frequency
SSI . . . . . Synchronous Serial Interface
TCP/IP . . . . . Transmission Control Protocol / Internet Protocol
UDP . . . . . User Datagram Protocol

2.4 Standards

The MotiFlex *e*100 has been designed and tested to comply with the following standards.

2.4.1 Design and test standards

- UL508C: Power Conversion Equipment.
- UL840: Insulation coordination including clearance and creepage distances for electrical equipment.
- EN61800-5-1: Adjustable speed electrical power drive systems. Safety requirements. Electrical, thermal and energy.
- EN50178: Electronic equipment for use in power installations.
- EN60529: Degrees of protection provided by enclosures.
- EN61800-3: When installed as directed in this manual, MotiFlex *e*100 conforms to the category C3 emission limits and the 'second environment' immunity requirements defined by this standard.

See also the CE certificate on page D-2.

2.4.2 Environmental test standards:

- EN60068-1: Environmental testing, general and guidance.
- EN60068-2-32: Environmental testing, Test Ed. Free Fall.
- EN60068-2-2: Environmental testing, Test B. Dry heat.
- EN60068-2-78: Environmental testing, Test cab. Damp heat, steady state.

2.4.3 Marks

CE c UL us

See also Appendix D for general recommendations for CE compliance.

3.1 Introduction

You should read all the sections in *Basic Installation* to ensure safe installation.
This section describes the mechanical and electrical installation of the MotiFlex *e*100 in the following stages:

- Location considerations.
- Mounting the MotiFlex *e*100.
- Connecting the AC power supply.
- Connecting the optional 24 VDC control circuit backup supply.
- Connecting the motor.
- Installing a regeneration resistor (Dynamic Brake).

3.1.1 Power sources

A 230 - 480 VAC 3-phase power source (IEC1010 over-voltage category III or less) in the installation area is required. An AC power filter is required to comply with the CE directive for which the MotiFlex *e*100 was tested (see section 3.4.10).

The optional 24 VDC control circuit backup supply must be a regulated power supply with a continuous current supply capability of up to 1.5 A, dependent on the number of option cards fitted. See section 3.6 for details.

3.1.2 Hardware requirements

The components you will need to complete the basic installation are:

- AC power supply filter (for CE compliance).
- The motor that will be connected to the MotiFlex *e*100.
- A motor power cable.
- An incremental encoder feedback cable, SSI cable, or BiSS / EnDat / SinCos cable. A separate Hall cable might also be required for linear motors.
- A USB cable.
- (Optional) 24 VDC control circuit backup power supply.
- (Optional) A regeneration resistor (Dynamic Brake) might be required, depending on the application. Without the regeneration resistor, the drive may produce an overvoltage fault. All MotiFlex *e*100 models have overvoltage sensing circuitry. Regeneration resistors may be purchased separately - see section 3.8 and appendix A.

- A PC with the following minimum specification:

	Minimum specification	Recommended specification
Processor	32-bit Intel / AMD processor, 500 MHz	32-bit or 64-bit Intel / AMD dual-core processor, 2 GHz or faster
RAM	256 MB	1 GB
Hard disk space	100 MB	100 MB
Communication	USB port (USB 1.1 full-speed), or Ethernet port (100 Mbit/s, independent of office network)*	
Screen	1024 x 768, 16-bit color	1280 x 1024, 16-bit color
Mouse	A mouse or similar pointing device. (Mint WorkBench does not support touch)	
Operating system	Windows XP	Windows XP, Windows Vista, or Windows 7 (32-bit or 64-bit)

* The Ethernet configuration used by a normal office PC is not suitable for direct communication with the MotiFlex *e*100. It is recommended to install a separate dedicated Ethernet adapter in the PC, which can be configured for use with the MotiFlex *e*100. See section 6.2.4.

3.1.3 Tools and miscellaneous hardware

- Your PC operating system user manual might be useful if you are not familiar with Windows.
- Small screwdriver(s) with a blade width of 2.5 mm (1/10 in) or less for connector X3.
- M5 screws or bolts for mounting the MotiFlex *e*100.

3.1.4 Other information needed for installation

This information is useful (but not essential) to complete the installation:

- The data sheet or manual provided with your motor, describing the wiring information of the motor cables/connectors.
- Knowledge of whether the digital input signals will be ‘Active Low’ or ‘Active High’.

3.2 Mechanical installation

It is essential that you read and understand this section before beginning the installation.

Take care when lifting. The 48 A and 65 A models weigh 12.45 kg (27.4 lb). Seek assistance if necessary. When carrying, do not suspend the unit from the removable front panels as they could detach and cause the unit to be dropped.

Avoid locating the MotiFlex *e*100 immediately above or beside heat generating equipment, or directly below water steam pipes.

Avoid locating the MotiFlex *e*100 in the vicinity of corrosive substances or vapors, metal particles and dust.

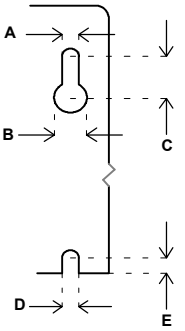
Failure to meet cooling air flow requirements will result in reduced product lifetime and/or drive overtemperature trips.

The safe operation of this equipment depends upon its use in the appropriate environment. The following points must be considered:

- The MotiFlex *e*100 must be installed indoors, permanently fixed and located so that it can only be accessed by service personnel using tools. When installed in a cabinet, the cabinet must have a volume of at least 0.19 m^3 (6.84 cu.ft). If not installed in a cabinet, barriers around the equipment are required.
- The maximum suggested operating altitude is 1000 m (3300 ft).
- The MotiFlex *e*100 must be installed where the pollution degree according to EN61800-5-1 shall not exceed 2.
- The optional 24 VDC control circuit backup supply must be installed so that the 24 VDC supplied to the unit is isolated from the AC supply either by using double or reinforced insulation, or by using basic insulation with a protective earth.
- The input of the control circuit must be limited to Extra Low Voltage circuits.
- Both the AC supply and the optional 24 VDC control circuit backup supply must be fused.
- The atmosphere must not contain flammable gases or vapors.
- There must not be abnormal levels of nuclear radiation or X-rays.
- To comply with CE directive 2004/108/EC an appropriate AC filter must be installed.
- The MotiFlex *e*100 must be secured by the slots in the metal mounting flanges. The protective earth/ground (the threaded studs on the top and bottom mounting flanges) must be bonded to a safety earth/ground using either a 25 A conductor or a conductor of three times the peak current rating - whichever is the greater.
- The metal tab at the bottom of the case is used for attaching a cable clamp (section A.1.6).
- The D-type connectors on the top and bottom panels of the MotiFlex *e*100 are secured using two hexagonal jack screws (sometimes known as “screwlocks”). If a jack screw is removed accidentally or lost it must be replaced with a #4-40 UNC jack screw with an external male threaded section no longer than 10 mm (0.4 in).
- The 48 A and 65 A MotiFlex *e*100 have a recess at the rear of the product which is filled with a block of packaging foam. Remove this foam before mounting the drive.

3.2.1 Dimensions - 1.5 A ~ 16 A models

Mounting hole and slot detail



A 6 mm
B 12 mm
C 12.7 mm
D 6 mm
E 6 mm

Dimensions shown as: **mm** *(inches)*.

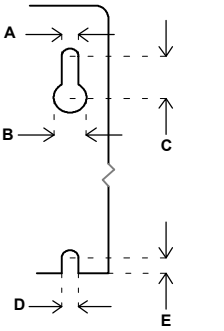
Depth: **260 mm** *(10.24 in)*
Weight:
1.5 A: 1.90 kg *(4.2 lb)*
3 A: 1.90 kg *(4.2 lb)*
6 A: 1.90 kg *(4.2 lb)*
10.5 A: 4.80 kg *(10.6 lb)*
16 A: 5.80 kg *(12.8 lb)*

Note: The case is 76 mm wide, which is 1 mm wider than the mounting plate. For this reason, when mounting multiple drives side-by-side for DC bus sharing, it is advisable to use the method described in section 3.2.4.1 to avoid errors when marking hole positions.

Figure 1 - Mounting and overall dimensions - 1.5 A ~ 16 A models

3.2.2 Dimensions - 21 A ~ 33.5 A models

Mounting hole and slot detail



A 6 mm
B 12 mm
C 12.7 mm
D 6 mm
E 6 mm

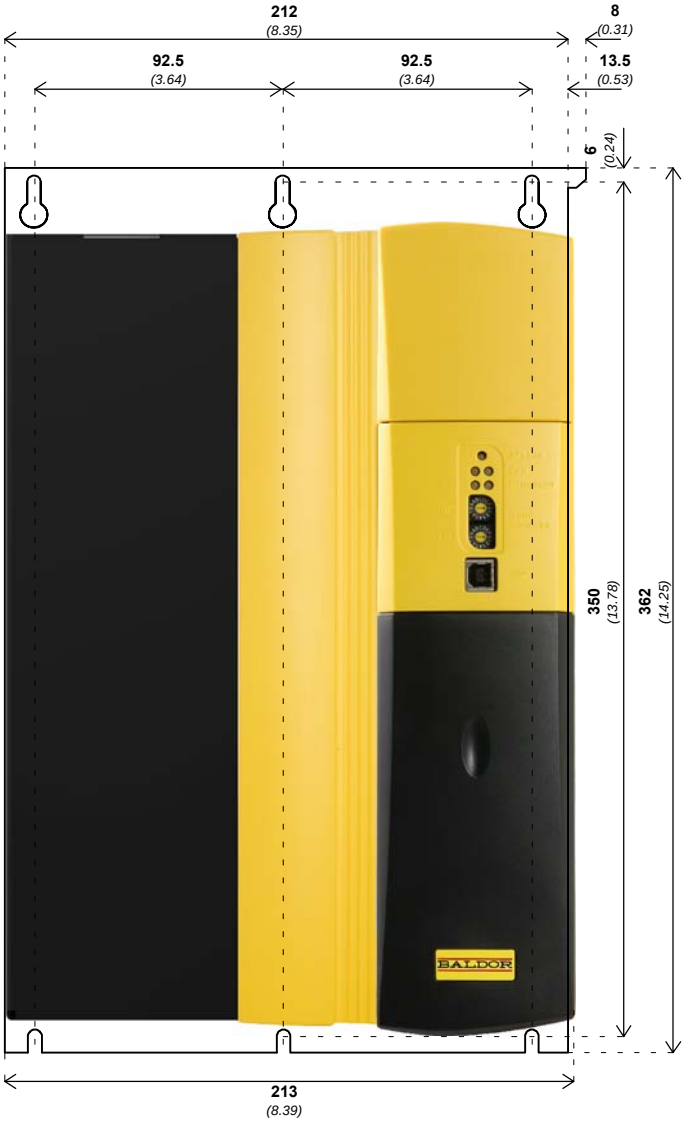
Dimensions shown as: **mm** *(inches)*.

Depth: **260 mm** *(10.24 in)*
Weight: 21 A: 5.85 kg *(12.9 lb)*
26 A: 6.35 kg *(14.0 lb)*
33.5 A: 6.35 kg *(14.0 lb)*

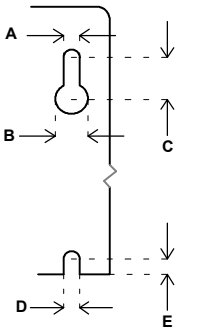
Note: The case is 128 mm wide, which is 1 mm wider than the mounting plate. For this reason, when mounting multiple drives side-by-side for DC bus sharing, it is advisable to use the method described in section 3.2.4.1 to avoid errors when marking hole positions.

Figure 2 - Mounting and overall dimensions - 21 A ~ 33.5 A models

3.2.3 Dimensions - 48 A ~ 65 A models



Mounting hole and slot detail



A 6 mm
B 12 mm
C 12.7 mm
D 6 mm
E 6 mm

Dimensions shown as: **mm** *(inches)*

Depth: **260 mm** *(10.24 in)*
Weight: 48 A: 12.45 kg *(27.4 lb)*
65 A: 12.45 kg *(27.4 lb)*

Note: The case is 213 mm wide, which is 1 mm wider than the mounting plate. For this reason, when mounting multiple drives side-by-side for DC bus sharing, it is advisable to use the method described in section 3.2.4.1 to avoid errors when marking hole positions.

Figure 3 - Mounting and overall dimensions - 48 A ~ 65 A models

3.2.4 Mounting the MotiFlex *e*100

Ensure you have read and understood the *Mechanical installation and location requirements* in section 3.2. Mount the MotiFlex *e*100 vertically on its rear side, the side opposite the front panel. M5 bolts or screws should be used to mount the MotiFlex *e*100. Detailed dimensions are shown in section 3.2.1.

Note: The 48 A and 65 A MotiFlex *e*100 have a recess at the rear of the product which is filled with a block of packaging foam. Remove this foam before mounting the drive.

For effective cooling, the MotiFlex *e*100 must be mounted upright on a smooth vertical metal surface. The MotiFlex *e*100 is designed to operate in an ambient temperature of 0 °C to 45 °C (32 °F to 113 °F). Output current must be derated between 45 °C (113 °F) and the absolute maximum ambient temperature of 55 °C (131 °F). All models incorporate cooling fans and are designed to operate without any additional cooling methods.

Temperature derating characteristics are shown in sections 8.3.5 to 8.3.14.

3.2.4.1 Mounting multiple drives for DC bus sharing

The MotiFlex *e*100 is designed to be mounted in close contact with other MotiFlex *e*100s, to allow the optional DC busbar kits (Baldor parts OPT-MF-DC-A, -B, -C or -D) to be connected across the top of the drives. Each busbar kit contains two busbars and the necessary screws. When mounting drives for DC bus sharing it is essential that they are accurately positioned in contact with the neighboring drive, otherwise the busbars will not fit.

Mount the rightmost drive first, but do not fully tighten the top left screw. Take the next drive and hold it against the left side of the first drive. Slide it downwards until the alignment tab (see Figure 4) on the side of the mounting flange fits behind the matching cutout on the first drive's mounting flange. Tighten the first drive's top left screw. Holding the second drive in place, mark its mounting holes. Remove the second drive, finish the mounting holes and then remount the drive. Use the same procedure to mount further drives to the left of the second drive.

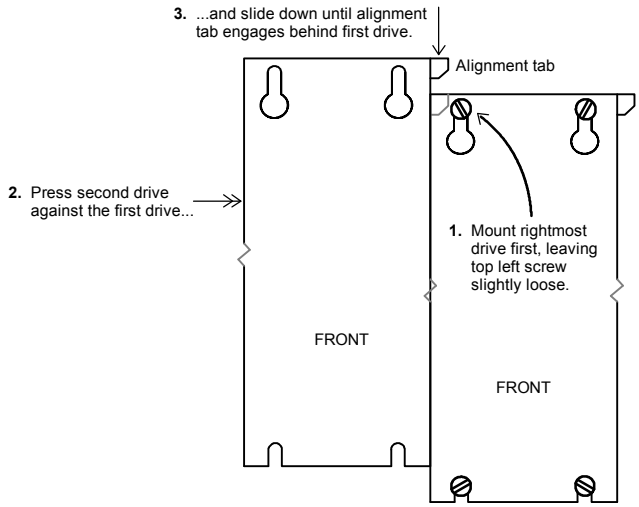

3. ...and slide down until alignment tab engages behind first drive.
Alignment tab
2. Press second drive against the first drive...
1. Mount rightmost drive first, leaving top left screw slightly loose.
FRONT
FRONT

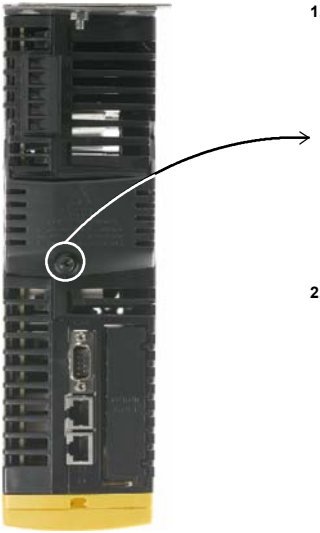
Figure 4 - Mounting MotiFlex *e*100s for DC bus sharing

3.2.4.2 Attaching the busbars for DC bus sharing

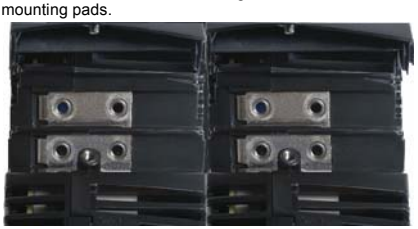
Busbars are supplied in kits, comprising a pair of busbars and all screws and washers required for fitting. There are 4 different busbar sizes, allowing any combination of narrow bodied MotiFlex *e*100 (1.5 A ~ 16 A models), wide bodied MotiFlex *e*100 (21 A ~ 33.5 A models) or extended bodied MotiFlex *e*100 (48 A ~ 65 A models) to be connected, as shown in Figure 6. Size 3 and size 4 busbars have an insulating sleeve, since parts of them are exposed when fitted. See also section 3.5 for details about sharing the DC bus.

DANGER

Hazardous voltages exist underneath the drive's hinged top cover! Before lifting the cover ensure that AC power has been removed from the source drive and at least 5 minutes have elapsed to allow the DC bus output capacitors to discharge. Use only original Baldor busbar kits, parts OPT-MF-DC-*x*.



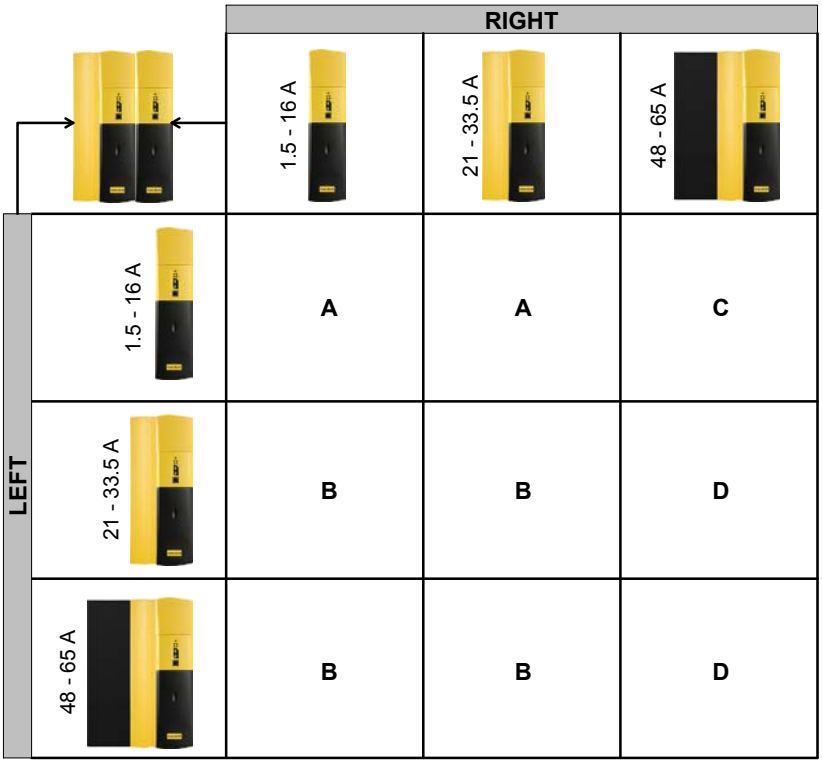
1. Loosen the busbar cover retaining screw to reveal the busbar mounting pads.



2. Attach the busbars using the supplied screws and washers. Tighten screws to approximately 2 N·m (17.7 lb-in).

3. Close the busbar cover and tighten the retaining screw to approximately 1 N·m (8.9 lb-in). Do not exceed 2 N·m (17.7 lb-in).

Figure 5 - Connecting busbars for DC bus sharing



Busbar selection:

1) From the LEFT column, select the drive that will be on the left.
2) From the RIGHT row, select the drive that will be on the right.
3) The intersecting letter indicates the busbar required to connect the selected drives.

   For example, **B** indicates that OPT-MF-DC-**B** is required.

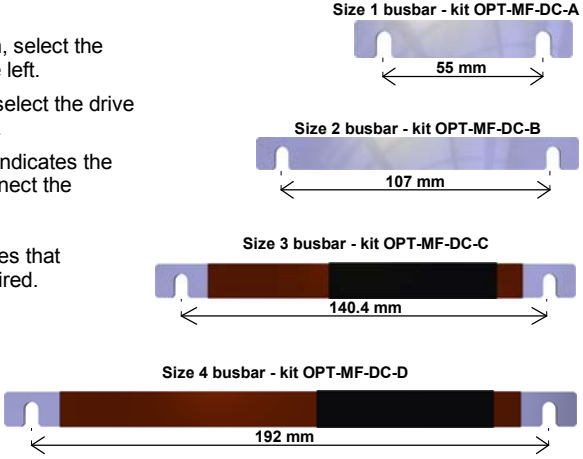

Size 1 busbar - kit OPT-MF-DC-A
55 mm
Size 2 busbar - kit OPT-MF-DC-B
107 mm
Size 3 busbar - kit OPT-MF-DC-C
140.4 mm
Size 4 busbar - kit OPT-MF-DC-D
192 mm

Figure 6 - Busbar requirements according to drive combinations

3.2.5 Overtemperature trips and intelligent fan control

The MotiFlex *e*100 contains internal temperature sensors that will cause it to trip and disable if the control card or output power module temperatures exceed preset values. These values are listed in the following table, and can also be read using the `TEMPERATURELIMITFATAL` keyword - see the Mint help file for details.

MotiFlex *e*100 catalog number	Maximum control card temperature	Maximum power module (PIM) temperature
MFE460A001	73 °C (163.4 °F)	105 °C (221 °F)
MFE460A003		
MFE460A006		
MFE460A010		115 °C (239 °F)
MFE460A016		
MFE460A021	62 °C (143.6 °F)	115 °C (239 °F)
MFE460A026		
MFE460A033		
MFE460A048	62 °C (143.6 °F)	115 °C (239 °F)
MFE460A065		

Table 1 - Maximum internal trip temperatures

The MotiFlex *e*100 can detect problems with its cooling fan, such as disconnection (fan loss) or overcurrent caused by stalling. The 10.5 A and 16 A models incorporate two cooling fans; one fan operates continuously, but to increase overall lifetime and efficiency the second fan operates only when necessary. Also, if a fault is detected on the first fan, the other one will turn on. The 48 A and 65 A models incorporate four cooling fans; none of the fans are required in normal conditions, but all four will operate when necessary.

3.2.5.1 Effects of mounting surface and proximity

If the MotiFlex *e*100 is mounted above or below another MotiFlex *e*100 (or other obstruction), there should be a minimum space of 90 mm to maintain effective cooling. Remember that when a MotiFlex *e*100 is mounted above another MotiFlex *e*100 or heat source, it will be receiving air that has been already heated by the device(s) below it.

3.3 Connector locations

3.3.1 Front panel connectors

To remove the top cover, push on the center of the bottom edge, then pull the top edge forwards. To refit, locate the cover over its intended position and then push on until it snaps into place.

Option slot 1 retaining screw.

X6 RS485 (2-wire)

1 TXA
2 TXB
3 GND
4 +7V out
5 *(NC)*
6 *(NC)*

LEDs

The STATUS, CAN and ETHERNET LEDs are described in section 7.2.1.

Node ID

These switches set the MotiFlex *e*100's node ID for Ethernet POWERLINK, and the final value of the IP address when using TCP/IP. See sections 5.8.1 and 6.2.4.

USB

1 *(NC)*
2 Data-
3 Data+
4 GND

To remove the bottom cover, push on the oval indentation and slide the cover downwards. To refit, insert the two tabs, protruding from the cover's top edge, into the main body. Push on the Baldor label to snap into place.

X2 18 VDC output / 24 VDC backup input

18 V out / 24 V in
0 V

X3 Input / Output

1	Status-	13	Status+
2	DGND	14	DGND
3	DOUT1-	15	DOUT1+
4	DIN2-	16	DIN2+
5	DGND	17	DGND
6	DIN1-	18	DIN1+
7	DIN0-	19	DIN0+
8	DGND	20	DGND
9	Drive enable-	21	Drive enable+
10	Shield	22	Shield
11	AGND	23	AGND
12	AIN0-	24	AIN0+

Option slot 2 retaining screw.

Tightening torque for terminal block connections (X2 & X3) is 0.5-0.6 N·m (4.4-5.3 lb-in).
Tightening torque for option slot 1/2 retaining screws is 0.7 N·m (6.2 lb-in).
Maximum wire / ferrule size (X2): 2.5 mm^2 (14 AWG).
Maximum wire size (X3): 0.5 mm^2 (20 AWG). Connector X3 is designed to accept bare wires only; do not use bootlace ferrules.
(NC) = Not Connected. Do not make a connection to this pin.

3.3.2 Top panel connectors

X1 AC power & regen (1.5 A ~ 16 A models)

L1	AC Phase 1
L2	AC Phase 2
L3	AC Phase 3
R1	Regeneration resistor
R2	

Tightening torque:
0.5-0.6 N·m (4.4-5.3 lb-in)
Maximum wire / ferrule size:
X1: 4 mm^2 (11 AWG).

X1 AC power & regen (21 A ~ 65 A models)

L1	AC Phase 1
L2	AC Phase 2
L3	AC Phase 3
R1	Regeneration resistor
R2	

Tightening torque:
L1/L2/L3: 1.7 N·m (15 lb-in)
R1/R2: 1.7 N·m (15 lb-in)
Maximum wire / ferrule size:
L1/L2/L3: 16 mm^2 (5 AWG).
R1/R2: 16 mm^2 (5 AWG).

Busbar cover retaining screw. Tightening torque is 1 N·m (8.9 lb-in).

CAN

1	(NC)
2	CAN-
3	CAN GND
4	*(NC)*
5	Shield
6	CAN GND
7	CAN+
8	*(NC)*
9	CAN V+

Option slot 1 cover

Ethernet

1	TX+
2	TX-
3	RX+
4	*(NC)*
5	*(NC)*
6	RX-
7	*(NC)*
8	Shield

Both connectors have identical pinouts.

3.3.3 Bottom panel connectors

X8 Feedback In

Pin	Incremental	SinCos	BiSS / SSI	EnDat
1	CHA+	*(NC)*	Data+	Data+
2	CHB+	*(NC)*	Clock+	Clock+
3	CHZ+	*(NC)*	*(NC)*	*(NC)*
4	Sense	Sense	Sense	Sense
5	Hall U-	Sin-	*(NC)*	Sin-*
6	Hall U+	Sin+	*(NC)*	Sin+*
7	Hall V-	Cos-	*(NC)*	Cos-*
8	Hall V+	Cos+	*(NC)*	Cos+*
9	CHA-	*(NC)*	Data-	Data-
10	CHB-	*(NC)*	Clock-	Clock-
11	CHZ-	*(NC)*	*(NC)*	*(NC)*
12	+5V out	+5V out	+5V out	+5V out
13	DGND	DGND	DGND	DGND
14	Hall W-	*(NC)*	*(NC)*	*(NC)*
15	Hall W+	*(NC)*	*(NC)*	*(NC)*
Shell	Shield	Shield	Shield	Shield

* EnDat v2.1 only. EnDat v2.2 does not use the Sin and Cos signals.

Option slot 2 cover

X16 Motor temperature switch

1	TH1
2	TH2

Tightening torque: 0.5-0.6 N·m (4.4-5.3 lb-in).
Maximum wire size: 2.5 mm^2 (14 AWG).

Cooling fan air inlet slots.
Ensure these slots remain free of obstructions at all times.

X17 Motor power out (1.5 A ~ 16 A models)

U	Motor U out
V	Motor V out
W	Motor W out

Tightening torque:
0.5-0.6 N·m (4.4-5.3 lb-in).
Maximum wire size:
4 mm^2 (11 AWG).

X17 Motor power out (21 A ~ 65 A models)

U	Motor U out
V	Motor V out
W	Motor W out

Tightening torque:
1.7 N·m (15 lb-in).
Maximum wire size:
16 mm^2 (5 AWG).

IMPORTANT NOTE!
Motor power cables must be correctly bonded to earth.
See section 3.7.1 for details.

3.4 AC power connections

This section provides instructions for connecting the AC power supply. For full specifications, see section 8.

The installer of this equipment is responsible for complying with NEC (National Electric Code) guidelines or CE (Conformite Europeene) directives and application codes that govern wiring protection, earthing/grounding, disconnects and other current protection.

Electrical shock can cause serious or fatal injury. Do not touch any power device or electrical connection before you first ensure that power has been disconnected and there is no high voltage present from this equipment or other equipment to which it is connected.

To prevent equipment damage, be certain that the input power has correctly rated protective devices installed.

To prevent equipment damage, be certain that input and output signals are powered and referenced correctly.

To ensure reliable performance of this equipment be certain that all signals to/from the MotiFlex *e*100 are shielded correctly.

MotiFlex *e*100 drives are designed to be powered from standard three-phase lines that are electrically symmetrical with respect to earth/ground. The power supply module within all MotiFlex *e*100 models provides rectification, smoothing and current surge protection. Fuses or circuit breakers are required in the input lines for cable protection.

Note: A Residual Current Device (RCD) must not be used for fusing the drive. An appropriate type of circuit breaker or fuse must be used.

All interconnection wires should be in metal conduits between the MotiFlex *e*100, AC power source, motor, host controller and any operator interface stations.

3.4.1 Earthing / grounding

Permanent earth/ground bonding points are provided on the mounting flanges, which must be used as the protective earth. They are labeled with the protective earth symbol and do not form any other mechanical function. Earthing methods are shown in section 3.4.4.

These protective earth/ground points prevent exposed metal parts of the MicroFlex *e*100 from becoming live in the event of a wiring error or other failure. Connecting these points to earth does not provide protection against electromagnetic contamination received or emitted by the drive and its associated wiring. For example, the motor power output cable supplies a high frequency high current waveform to the motor, so the cable's shielding must be separately bonded to a functional earth point to prevent the cable radiating electromagnetic contamination into the surrounding area. Such contamination can cause spurious errors in apparently unrelated parts of the installation, such as low voltage communication cables. See sections 3.4.2 and 3.7.1 for detailed installation instructions that will help reduce electromagnetic contamination.

Note: When using unearthed/ungrounded distribution systems, an isolation transformer with an earthed/grounded secondary is recommended. This provides three-phase AC power that is symmetrical with respect to earth/ground and can prevent equipment damage.

3.4.2 AC input and regeneration resistor output wiring

The installation methods shown in Figure 7 will improve the reliability of the system, reduce troubleshooting time, and optimize the EMC (electromagnetic compatibility) behavior of the control system. The MotiFlex *e*100's protective earth connection does not provide electromagnetic compatibility. Its purpose is to prevent exposed metalwork becoming live in the case of a serious failure. To avoid EMC coupled effects within the panel design:

1. Do not run AC filter input and output power cables in close proximity.
2. Do not run motor output power cables with any other cables, especially Ethernet, signal cables, or 'clean' AC power.
3. Do not run power and signal cables in the same trunking. If the cables must run in parallel, they should be separated by 200 mm (8 in) or placed in separate metal trunking.
4. If any of the above cables must cross, they must do so at 90 degrees to minimize coupling.
5. Ensure all sources of electrical noise are suppressed, e.g. solenoids, relays, contactors.

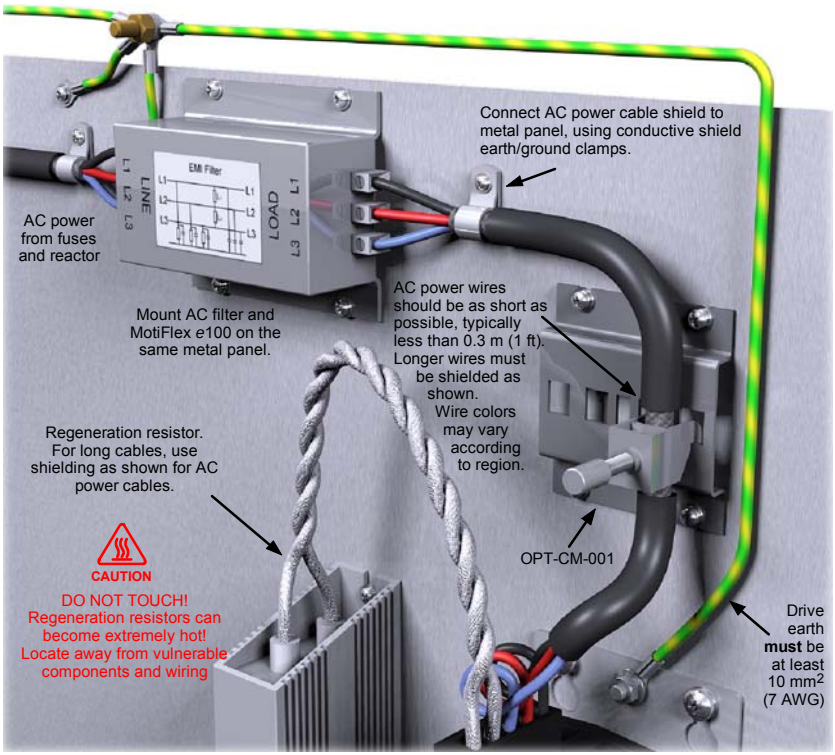

Connect AC power cable shield to metal panel, using conductive shield earth/ground clamps.
AC power from fuses and reactor
EMI Filter
LINE
LOAD
Mount AC filter and MotiFlex e100 on the same metal panel.
AC power wires should be as short as possible, typically less than 0.3 m (1 ft). Longer wires must be shielded as shown. Wire colors may vary according to region.
Regeneration resistor. For long cables, use shielding as shown for AC power cables.
OPT-CM-001
CAUTION
DO NOT TOUCH! Regeneration resistors can become extremely hot! Locate away from vulnerable components and wiring
Drive earth must be at least 10 mm² (7 AWG)

Figure 7 - Panel layout best practice

3.4.3 Earth leakage

The following table shows typical earth leakage figures for a MotiFlex *e*100 with a 20 m (66 ft) motor cable, in combination with each of the recommended AC power filters (see section 3.4.10).

MotiFlex *e*100 with:		**Typical combined earth leakage** (mA)
AC power filter	**Motor cable**	
None	None	6.24
FI0035A00 (8 A)	20 m	28.6
FI0035A01 (16 A)	20 m	38.7
FI0035A02 (25 A)	20 m	38.7
FI0035A04 (50 A)	20 m	45.4
FI0035A05 (66 A)	20 m	60.0
Internal filter (MFE460A048 MFE460A065 models only)	25 m	63.7

If the MotiFlex *e*100 and filter are mounted in a cabinet, the minimum size of the protective earthing conductor shall comply with the local safety regulations for high protective earthing conductor current equipment. The conductor must be 10 mm^2 or larger to satisfy EN61800-5-1.

3.4.3.1 Protection class

User protection has been achieved using Protective Class I, which requires an earth connection to the unit whenever hazardous voltages are applied. The equipment provides protection against electric shock by:

- Means of connection of protective earth to accessible live conductive parts.
- Basic insulation.

3.4.4 AC power connections

Location	Connector X1 (top panel)
Mating connector 1.5 A ~ 16 A models 21 A ~ 33 A models 48 A ~ 65 A models	 Phoenix POWER COMBICON PC 4/ 5-ST-7,62 Phoenix POWER COMBICON PC 16/ 3-ST-10,16 Phoenix POWER COMBICON SPC 16/ 3-ST-10,16
Nominal input voltage	230 VAC or 480 VAC, 3Φ line to line
Minimum input voltage	180 VAC, 3Φ line to line (see Note)
Maximum input voltage	528 VAC, 3Φ line to line

Note: The MotiFlex *e*100 will trip if the DC-bus voltage falls below 200 V or 60% of the no-load voltage, whichever occurs first. The MotiFlex *e*100 will stop operating if the DC-bus voltage falls below 150 VDC, unless a 24 VDC control circuit backup supply is present (see section 3.6).

Connect the supply to L1, L2 and L3 as shown in Figure 8. For CE compliance, an AC filter must be connected between the AC power supply and the MotiFlex *e*100. If local codes do not specify different regulations, use at least the same gauge wire for earth/ground as is used for L1, L2 and L3. The threaded studs protruding from the top and bottom case flanges can be used as the earth/ground connection (PE).

For 1.5 A ~ 16 A models, tightening torque for X1 terminal block connections is 0.5-0.6 N·m (4.4-5.3 lb-in). The 21 A ~ 65 A models use a spring cage connector. For all models, tightening torque for the flange mounted PE connection is 2.5 N·m (22.1 lb-in).

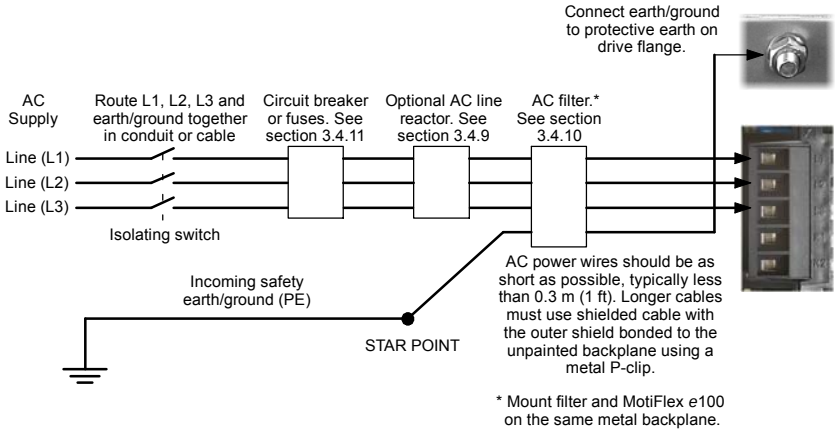

Connect earth/ground to protective earth on drive flange.
AC Supply
Route L1, L2, L3 and earth/ground together in conduit or cable
Circuit breaker or fuses. See section 3.4.11
Optional AC line reactor. See section 3.4.9
AC filter.* See section 3.4.10
Line (L1)
Line (L2)
Line (L3)
Isolating switch
Incoming safety earth/ground (PE)
STAR POINT
AC power wires should be as short as possible, typically less than 0.3 m (1 ft). Longer cables must use shielded cable with the outer shield bonded to the unpainted backplane using a metal P-clip.
* Mount filter and MotiFlex e100 on the same metal backplane.

Figure 8 - Three-phase power connections - 1.5 A ~ 16 A models

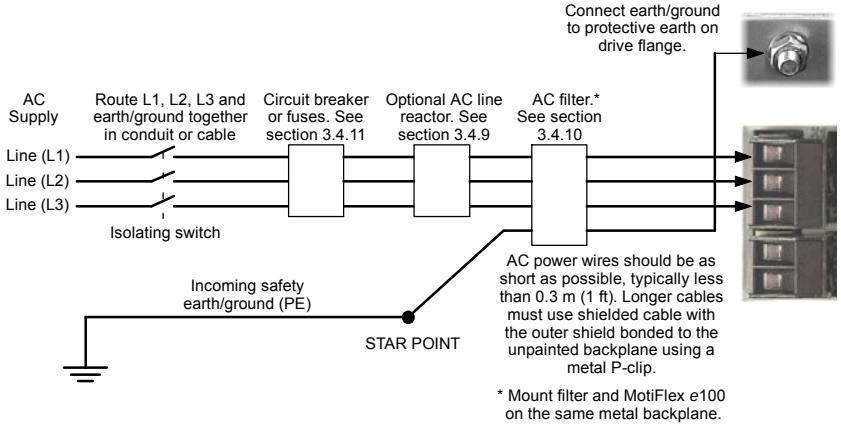

Connect earth/ground to protective earth on drive flange.
AC Supply
Route L1, L2, L3 and earth/ground together in conduit or cable
Circuit breaker or fuses. See section 3.4.11
Optional AC line reactor. See section 3.4.9
AC filter.* See section 3.4.10
Line (L1)
Line (L2)
Line (L3)
Isolating switch
Incoming safety earth/ground (PE)
STAR POINT
AC power wires should be as short as possible, typically less than 0.3 m (1 ft). Longer cables must use shielded cable with the outer shield bonded to the unpainted backplane using a metal P-clip.
* Mount filter and MotiFlex e100 on the same metal backplane.

Figure 9 - Three-phase power connections - 21 A ~ 65 A models

3.4.5 AC power cycling

After AC power has been removed, no delay is necessary before reapplying AC power. However, note that after AC power has been removed from the MotiFlex *e*100, high voltages (greater than 50 VDC) can remain on power connections for up to 5 minutes, while the DC bus circuitry discharges. Do not touch the DC bus, regeneration resistor, or other power connections during this period.

3.4.6 Inrush current

The inrush current is limited by pre-charge circuitry and is lower than the maximum AC current expected under full load conditions (see section 8), so it should not affect fusing or supply circuit design.

3.4.7 Phase loss detection

The MotiFlex *e*100 requires all three phases to be present. If any phase is lost, the MotiFlex *e*100 will immediately trip and disable, reporting a phase loss error (error 10029). See the Mint help file for details about handling errors.

3.4.8 Drive overload protection

The MotiFlex *e*100 will immediately trip and disable if there is an overload condition. The parameters for managing drive overloads are configured automatically by the Commissioning Wizard (see section 6.4.3). If they need to be changed, use the Parameters tool in Mint WorkBench (see section 6.5.1).

3.4.9 Input power conditioning

Certain power line conditions must be avoided; an AC line reactor, an isolation transformer or a step up/step down transformer may be required for some power conditions.

If the feeder or branch circuit that provides power to the MotiFlex *e*100 has permanently connected power factor correction capacitors, an input AC line reactor or an isolation transformer must be connected between the power factor correction capacitors and the MotiFlex *e*100.

AC line reactors may also be required under certain conditions, for example:

- If the AC supply harmonic distortion is greater than 5%. Harmonic distortion typically occurs in regions where the quality of the AC supply is poor, for example Israel or India, and in heavy industry.
- The supply phases are imbalanced. An imbalanced supply typically occurs where one phase of the local three-phase supply is being used more than the other phases.
- The supply contains commutation notches. These typically occur in heavy industry, and are caused by the commutation of large power semiconductor devices in equipment such as large thyristor converters.
- The MotiFlex *e*100 is sharing its DC bus with other drives (see section 3.5).

See section A.1.3 for a range of suitable line reactors.

If the feeder or branch circuit that provides power to the MotiFlex *e*100 has power factor correction capacitors that are switched on line and off line, the capacitors must not be switched while the drive is connected to the AC power line. If the capacitors are switched on line while the drive is still connected to the AC power line, additional protection is required. A Transient Voltage Surge Suppressor (TVSS) of the proper rating must be installed between the AC line reactor (or isolation transformer) and the AC input to the MotiFlex *e*100.

3.4.10 Power supply filters

To comply with EC directive 2004/108/EC, an AC power filter of the appropriate type must be connected. This can be supplied by Baldor and will ensure that the MotiFlex *e*100 complies with the CE specifications for which it has been tested. Ideally one filter should be provided for each MotiFlex *e*100, except in DC bus sharing applications where only the source drive requires a filter. Filters should not be shared between drives or other equipment. Table 2 lists the appropriate filters:

MotiFlex *e*100 catalog number	Recommended Baldor AC power filters	Filter current rating (RMS)	Meets EN61000-6-4 Industrial standard (class A)	Meets EN61800-3 Drives Standard
MFE460A001	FI0035A00	8A	No	Yes
	FI0035A01	16A	No	Yes
MFE460A003	FI0035A00	8A	No	Yes
	FI0035A01	16A	No	Yes
MFE460A006	FI0035A01	16A	No	Yes
MFE460A010	FI0035A01	16A	No	Yes
	FI0035A02	25A	Yes	Yes
MFE460A016	FI0035A02	25A	Yes	Yes
MFE460A021	FI0035A03	36A	Yes	Yes
	FI0035A04	50A	No	Yes
	FI0035A05	66A	No	Yes
MFE460A026	FI0035A03	36A	Yes	Yes
	FI0035A04	50A	No	Yes
	FI0035A05	66A	No	Yes
MFE460A033	FI0035A04	50A	No	Yes
	FI0035A05	66A	No	Yes
MFE460A048	FI0035A05	66A	Yes	Yes
	Opt. internal	-	No	Yes
MFE460A065	FI0035A05	66A	Yes	Yes
	Opt. internal	-	No	Yes

Table 2 - Baldor filter part numbers

For filter earth leakage figures, see section 3.4.3.

Note: The MotiFlex *e*100 is not intended to be used on a low-voltage public network which supplies domestic premises. Radio frequency interference is expected if used on such a network.

3.4.11 Power disconnect and protection devices

A power disconnect should be installed between the input power supply and the MotiFlex *e*100 for a fail-safe method to disconnect power. The MotiFlex *e*100 will remain in a powered condition until all input power is removed from the drive and the internal bus voltage has depleted. The MotiFlex *e*100 must have a suitable input power protection device installed, preferably a fuse.

Recommended circuit breakers are thermal magnetic devices with characteristics suitable for heavy inductive loads (C-type trip characteristic for 1.5 A ~ 16 A models, B-type trip characteristic for 21 A ~ 65 A models. Circuit breaker or fuses are not supplied. See sections 8.2.2 to 8.2.4 for recommended ratings. For CE compliance, see Appendix D.

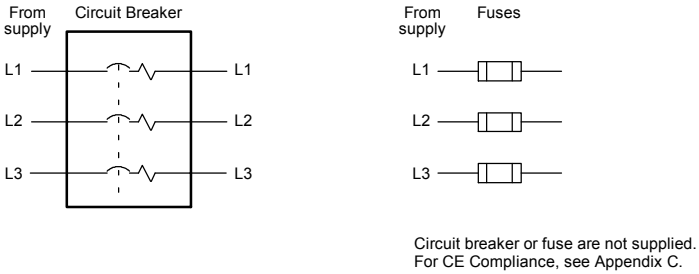


Figure 10 - Circuit breaker and fuses

Note: Metal conduit or shielded cable should be used. Connect conduits so the use of a line reactor or RC device does not interrupt EMI/RFI shielding.

3.4.11.1 Discharge period

After AC power has been removed from the MotiFlex *e*100, high voltages (greater than 50 VDC) can remain on power connections for up to 5 minutes, while the DC bus circuitry discharges. Do not touch the DC bus, regeneration resistor, or other power connections during this period.

3.4.12 Recommended wire sizes

All wire sizes are based on 75 °C (167 °F) copper wire. Use copper conductors only. Higher temperature smaller gauge wire may be used per National Electric Code (NEC) and local codes.

MotiFlex *e*100 catalog number	AC input & motor output wire size	
	AWG	mm^2
MFE..A001	14	2.5
MFE..A003	14	2.5
MFE..A006	14	2.5
MFE..A010	10	6.0
MFE..A016	10	6.0
MFE..A021	8	10.0
MFE..A026	8	10.0
MFE..A033	8	10.0
MFE..A048	4	20.0
MFE..A065	4	20.0

Table 3 - AC input and motor output wire sizes

3.5 Sharing the DC bus

The AC power supply is rectified and smoothed within the MotiFlex *e*100 to create a typical 'DC bus' voltage of around 678 VDC (when using a 480 VAC supply). The DC bus voltage is then switched by a power module to create the UVW output waveforms that drive the motor. The MotiFlex *e*100 is capable of sharing its DC bus voltage with similar drives mounted beside it, using solid metal busbar connections between the drives. In a group of drives, this significantly reduces the amount of AC power supply wiring, filters, fuses and breakers, since these are only required by the single drive that is generating the DC bus voltage (the source drive). Furthermore, only one regeneration resistor is required for the group (see section 3.8). The DC bus outputs are conditionally short-circuit proof according to EN61800-5-1, 6.2.

When sharing the DC bus, revised AC input current ratings apply. See section 8.

3.5.1 DC busbar connection

DANGER

Hazardous voltages exist underneath the drive's hinged top cover! Before lifting the cover ensure that AC power has been removed from the source drive and at least 5 minutes have elapsed to allow the DC bus output capacitors to discharge.

NOTICE

When sharing the DC bus, special care must be taken to calculate the total peak and continuous supply current requirement of the drives, since they will all derive power from the source drive's DC bus.

NOTICE

Only the source drive must be connected to the AC power source so that it can generate the DC bus voltage. The receiving drives sharing the DC bus must not be connected to the AC power source.

NOTICE

In the unlikely event that one of the MotiFlex *e*100's DC bus capacitors should fail with a short circuit, an internal fast-acting fuse will trip. These fuses are not user replaceable. Similar fuses in other drives sharing the DC bus are also likely to trip.

The top panel of the MotiFlex *e*100 incorporates a cover that conceals the DC busbar output pads. To allow sharing of the DC bus, optional busbar kits (Baldor parts OPT-MF-DC-A, -B, -C or -D) must be attached to these pads using the screws supplied with the busbars. Lift the front edge of the cover to access the DC bus output pads. Since the busbars have a fixed length, accurate positioning of adjacent drives is critical to ensure the busbars will fit. See section 3.2.4 for details of busbars and fitting dimensions.

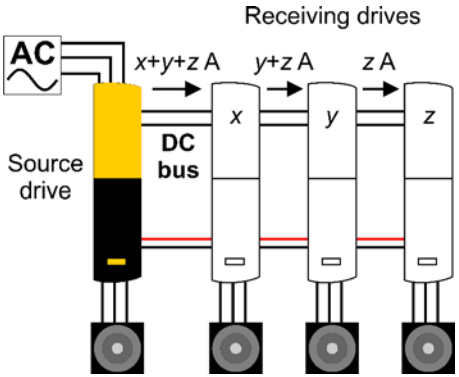


Figure 11 - Shared DC bus connections

3.5.2 'Power ready' input / output

A digital output on the source drive must be connected to a digital input on each of the receiving drives (see Figure 12). This allows the source drive to inform the receiving drives when the DC bus is ready for use. On each drive, the chosen output / input must also be configured as the power ready output / input. Failure to connect and configure a 'power ready' signal will result in the receiving drive reporting a 'power base not ready' error.

The configuration of the power ready output or input is performed in Mint WorkBench's *Drive Setup Wizard*, which appears as part of the Commissioning Wizard. This is explained in section 6.4.4.2. The `POWERREADYOUTPUT` and `POWERREADYINPUT` keywords provide an alternative method for assigning the power ready output and input. See the Mint help file for details.

The input and output must both be 'active high', and the input must also be level triggered (the default settings).

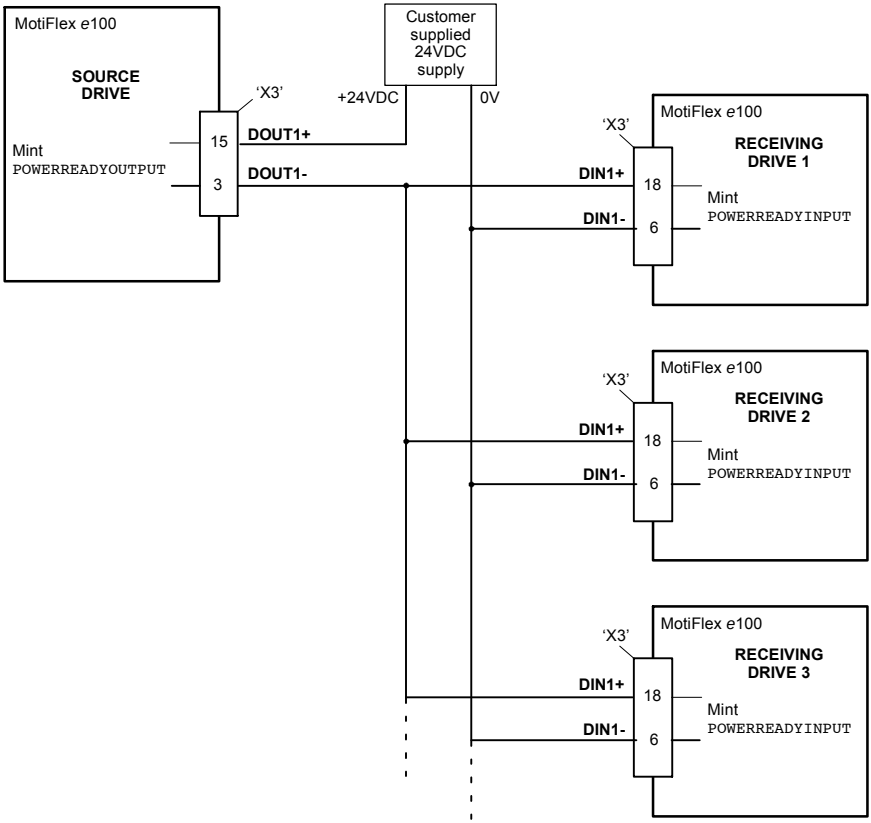


Figure 12 - 'Power ready' output and input connections

3.5.3 Line reactors

When a drive is sharing its DC bus, a line reactor must be fitted. This should be connected between the source drive's fuse (or circuit breaker) and the AC input filter (see Figure 8 on page 3-17). See section A.1.3 for further details.

MotiFlex *e*100 catalog number	Required line reactor inductance (mH)	Recommended Baldor AC line reactor
MFE460A001	1.2	LRAC02502
MFE460A003		
MFE460A006		
MFE460A010	0.8	LRAC03502
MFE460A016		
MFE460A021	0.5	LRAC05502
MFE460A026		
MFE460A033		
MFE460A048	0.4	LRAC08002
MFE460A065		

Table 4 - Baldor line reactor part numbers

3.6 18 VDC out / 24 VDC in control circuit backup supply

Location	Connector X2 (Mating connector: Phoenix COMBICON MVSTBR 2,5 HC/ 2-ST-5,08)
	When operating as an 18 V output:
Nominal output voltage	15 VDC
Range	12-19 VDC
Output current (maximum)	50 mA (limited by PTC)
	When operating as a backup supply input:
Nominal input voltage	24 VDC
Range	20-30 VDC
Maximum input current (max. @ 24V)	1.2 A

When the AC supply is present (section 3.4), connector X2 provides an 18 VDC output. This may be used for various purposes such as:

- A permanent connection to the drive enable input in applications where an external controller will not be used to enable the drive (see section 5.3.1).
- A source for creating a variable analog input voltage (see Figure 43 on page 5-3).
- To provide the source supply for digital outputs (see sections 5.3.6 and 5.3.7).

Take particular care not to exceed the 18 V supply's maximum output current of 50 mA. Exceeding this current will cause a self-resetting fuse to operate, which may take up to 20 seconds to reset after the load has been removed. Tightening torque for terminal block connections is 0.5-0.6 N·m (4.4-5.3 lb-in).

The 18 VDC output is fully short-circuit proof according to EN61800-5-1, 6.2.

3.6.1 24 VDC backup supply

Optionally, an external fused 24 VDC backup supply may be connected directly to connector X2 to power the controlling electronics. During normal operation, this supply is not used by the MotiFlex *e*100. However, if AC power (or shared DC bus power) is lost or needs to be removed from the drive, the controlling electronics will lose their internal supply. In this situation, the external 24 VDC supply is employed to ensure the controlling electronics remain powered and retain position and I/O information.

For detailed specifications of the 18 VDC out / 24 VDC in connection, see section 8.5.

3.6.2 24 VDC control circuit backup supply wiring

When multiple MotiFlex *e*100 are mounted side-by-side for DC bus sharing (see section 3.5), the 24 VDC backup supply wiring can be reduced. A channel and supporting tabs are built-in to the front panel of the drive to allow easy 'daisy-chaining' of the 24 VDC backup supply, as shown in Figure 13.

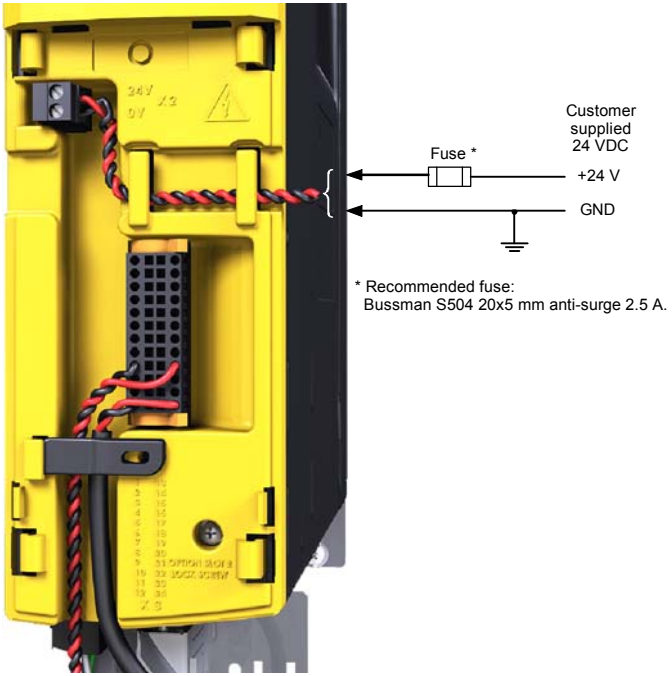


Figure 13 - 'Daisy-chained' 24 VDC backup supply wiring

3.7 Motor connections

Location	Connector X17 (bottom panel)	
Mating connector 1.5 A ~ 16 A models 21 A ~ 33 A models 48 A ~ 65 A models	 Phoenix POWER COMBICON PC 4/ 3-ST-7,62 Phoenix POWER COMBICON IPC 16/ 3-ST-10,16 Phoenix POWER COMBICON ISPC 16/ 3-ST-10,16	
AC supply voltage	230 VAC, 3Φ	480 VAC, 3Φ
Output voltage range	0-230 VAC, 3Φ	0-480 VAC, 3Φ

MotiFlex *e*100 will operate with a large number of brushless servo motors. For information on selecting Baldor servo motors please see the sales brochure BR1202, available from your local Baldor representative. The motor must be capable of being powered by an inverter PWM output - see sections 8.3.1 to 8.3.3 for details. The motor can be connected directly to the MotiFlex *e*100 or through a motor contactor (M-Contactor). The motor outputs are fully short-circuit proof according to EN61800-5-1, 6.2. Motors should ideally have a minimum inductance of 1 mH per winding; for motors with lower inductance an output reactor may be fitted in series with the motor.

When using a Baldor motor, the parameters for managing motor overloads are configured automatically by the Commissioning Wizard (see section 6.4.3). If they need to be changed, or you are using an alternative motor, use the Parameters tool in Mint WorkBench (see section 6.5.1).

For full motor output specifications, see section 8.3.

Hazardous voltages can exist on the motor output connections. Do not touch the motor output connections before you first ensure there is no high voltage present.

The motor leads U, V and W must be connected to their corresponding U, V or W terminal on the motor. Misconnection will result in uncontrolled motor movement.

Do not connect AC supply power to the MotiFlex *e*100 UVW outputs. This could damage the MotiFlex *e*100.

For CE compliance, the motor earth/ground should be connected to the drive earth/ground, and the motor power cable must be shielded; see section 3.7.1. The connector or gland used at the motor must provide 360 degree shielding. The maximum recommended cable length is 30.5 m (100 ft). See section 3.4.12 for recommended wire sizes.

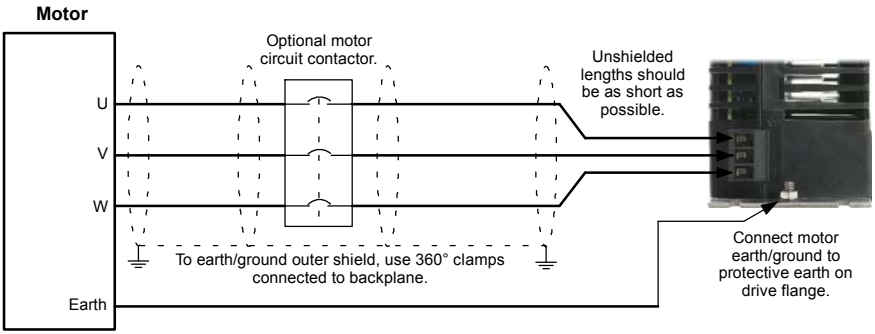


Figure 14 - Motor connections - 1.5 A ~ 16 A models

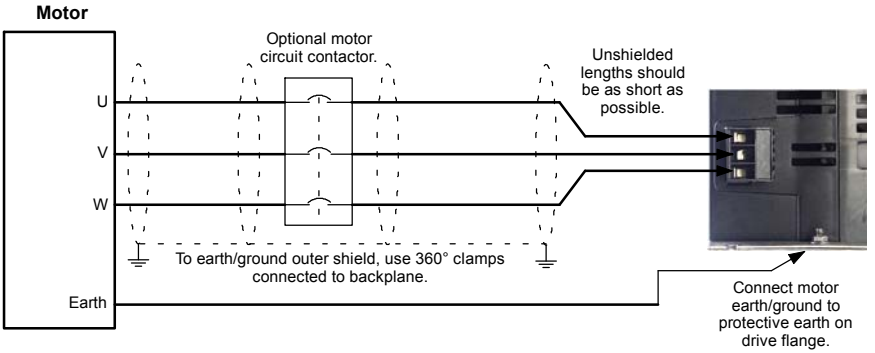


Figure 15 - Motor connections - 21 A ~ 65 A models

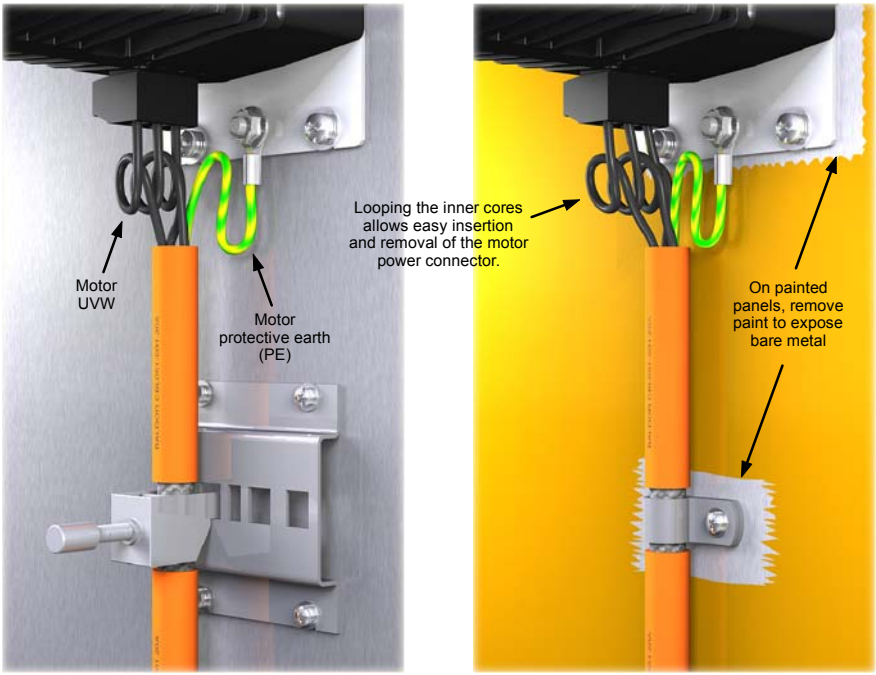
For 1.5 A ~ 16 A models, tightening torque for X17 terminal block connections is 0.5-0.6 N·m (4.4-5.3 lb-in). The 48 A ~ 65 A models use a spring cage connector. For all models, tightening torque for the flange mounted PE connection is 2.5 N·m (22.1 lb-in).

3.7.1 Motor cable shielding

It is essential that the motor cable shield is correctly bonded to a functional earth, typically the same earthed metal backplane on which the MotiFlex *e*100 is mounted. The motor power output cable carries a high frequency high current waveform to the motor, so the cable's shielding must be earthed to prevent the cable radiating electromagnetic contamination into the surrounding area. Such contamination can cause spurious errors in apparently unrelated parts of the installation, such as low voltage communication cables. To provide a low impedance path to earth and effective shielding, the conductor must provide contact with a large proportion of the cable's circumference. Figure 16 shows two possible methods.

3.7.1.1 Exposing the cable shield

1. Make a single circular cut in the cable's outer sheath, ensuring that the cable's braided shield is not damaged.
2. Slide the section of outer sheath towards the end of the cable to expose an area of braided shield. Carefully remove the excess sheath at the end of the cable.
3. Attach the metal P-clip or clamp to the exposed area of braided shield.
4. Ensure that the P-clip (or Motor Cable Management Bracket) is securely attached to an unpainted area of the metal backplane.



Using the optional Motor Cable Management Bracket OPT-CM-001 (recommended)

Using a metal P-clip

Figure 16 - Motor connections - physical cable arrangement

3.7.1.2 Continuation of motor power cable shielding

When using a motor contactor, or extending the motor cable through a terminal box, ensure that the motor cable shielding is continued all the way to the motor.

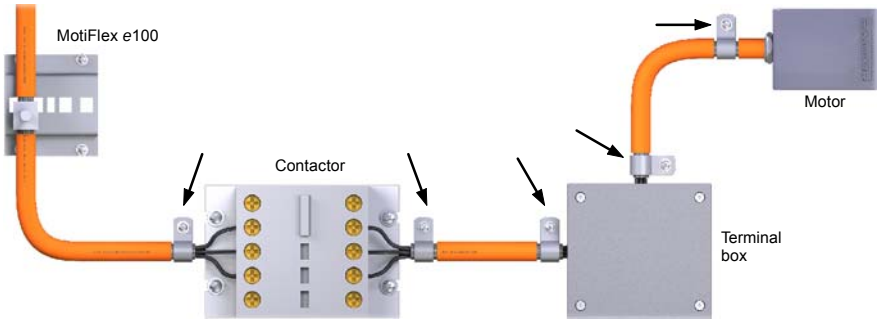


Figure 17 - Continuation of motor power cable shielding

3.7.2 Motor circuit contactor

If required by local codes or for safety reasons, an M-Contactor (motor circuit contactor) may be installed to provide a physical disconnection of the motor windings from the MotiFlex *e*100 (see Figure 14). Opening the M-Contactor ensures that the MotiFlex *e*100 cannot drive the motor, which may be necessary during equipment maintenance or similar operations. Under certain circumstances, it may also be necessary to fit a brake to a rotary motor. This is important with hanging loads where disconnecting the motor windings could result in the load falling. Contact your local supplier for details of appropriate brakes. Ensure that shielding of the motor cable is continued on both sides of the contactor.

CAUTION

If an M-Contactor is installed, the MotiFlex *e*100 must be disabled at least 20 ms before the M-Contactor is opened. If the M-Contactor is opened while the MotiFlex *e*100 is supplying power to the motor, the MotiFlex *e*100 could be damaged. Incorrect installation or failure of the M-Contactor or its wiring could result in damage to the MotiFlex *e*100.

3.7.3 Sinusoidal filter

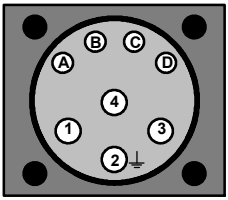
A sinusoidal filter is used to provide a better quality waveform to the motor, reducing motor noise, temperature and mechanical stress. It will reduce or eliminate harmful dV/dt values (voltage rise over time) and voltage doubling effects which can damage motor insulation. This effect occurs most noticeably when using very long motor cables, for example 30.5 m (100 ft) or more. Baldor motors intended to be used with drives are designed to withstand the effects of large dV/dt and overvoltage effects. However, if very long motor cables are unavoidable and are causing problems, then a sinusoidal filter may be beneficial.

3.7.4 Motor power cable pin configuration - Baldor BSM rotary motors

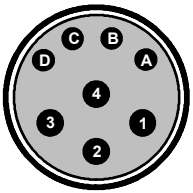
Figure 18 shows the pin configuration for a typical Baldor motor cable, part number CBL025SP-12:

Signal name	Motor / cable pin	Motor cable wire color
Motor U	1	Black, labeled '1'
Motor V	4	Black, labeled '2'
Motor W	3	Black, labeled '3'
Earth/ground	2	Green/Yellow
Thermal switch	A	Green
Thermal switch	B	White
Brake	C	Blue
Brake	D	Red

Note:
Not all motors are fitted with a brake so pins C and D might not be connected.



Motor power connector (male)



Cable connector end view (female)

Figure 18 - Baldor motor power cable pin configuration

3.7.5 Motor cable pin configuration - Baldor linear motors

The following table shows the pin colors used in a typical Baldor linear motor cable set, part number AY1763A00:

Signal name	Motor cable wire color
Motor U	Black
Motor V	Red
Motor W	White
Motor ground	Green
Thermal switch	Blue
Thermal switch	Orange

Signal name	Hall cable wire color
Hall 1 (U)	White
Hall 2 (V)	Red
Hall 3 (W)	Black
Hall ground	Green
Hall +5 VDC	Brown

3.7.6 Motor brake connection

You might wish to wire a motor's brake, via a relay, to a digital output on connector X3 (see sections 5.3.6 and 5.3.7). This allows the MotiFlex *e*100 to control the motor's brake. A typical circuit is shown in Figure 19.

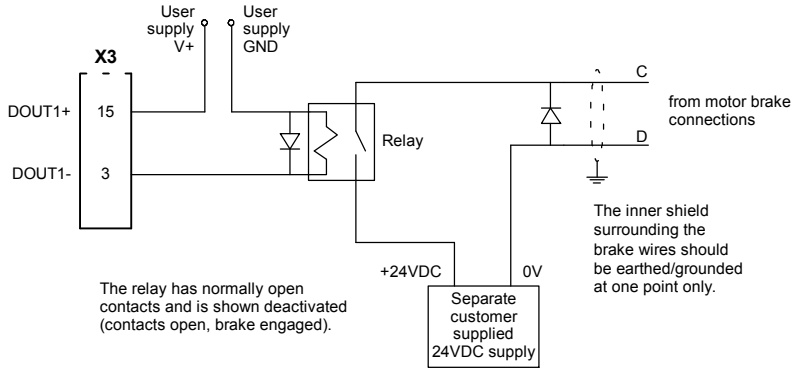


Figure 19 - Motor brake control circuit

WARNING

The 24 VDC power supply must be a separate supply as shown in Figure 19. Do not use the 'user supply' powering the MotiFlex *e*100 digital outputs, or the internally generated 18 VDC supply. The brake wires often carry noise that could cause erratic drive operation or damage. The brake contacts must never be wired directly to the digital outputs. The relay and motor brake terminals should be fitted with protective flyback diodes, as shown in Figure 19.

This circuit uses a special motor brake output, configured using `MOTORBRAKEOUTPUT` to appear on DOUT1. The operation of the motor brake output is synchronized with the application of power to the motor and the enabling / disabling of the drive. Configurable delays are included to allow time for the relay contacts and the brake to engage or release (see `MOTORBRAKEDELAY` in the Mint help file). This system allows controlled operation of suspended or tensioned loads that are held by the brake. For example:

To engage the brake:

- The motor is brought to rest under normal control, but remains powered;
- The relay is deactivated, causing the brake to engage;
- Power is removed from the motor;
- The drive is disabled.

To disengage the brake:

- The drive is enabled;
- Power is applied to the motor to hold position under normal control;
- The relay is activated, causing the brake to be disengaged;
- Motion starts.

3.7.7 Motor overtemperature input

The motor overtemperature input is a dedicated input which may be directly connected to the motor's thermal switch. When the motor overheats and triggers the overtemperature input, the MotiFlex *e*100 is normally disabled. See section 5.3.5 for details.

3.7.8 Bottom panel wiring

It is important that signal cables are properly shielded. Optional bracket OPT-CM-002 / -003 allows easy screening and attachment of other signal cables. See section A.1.6.

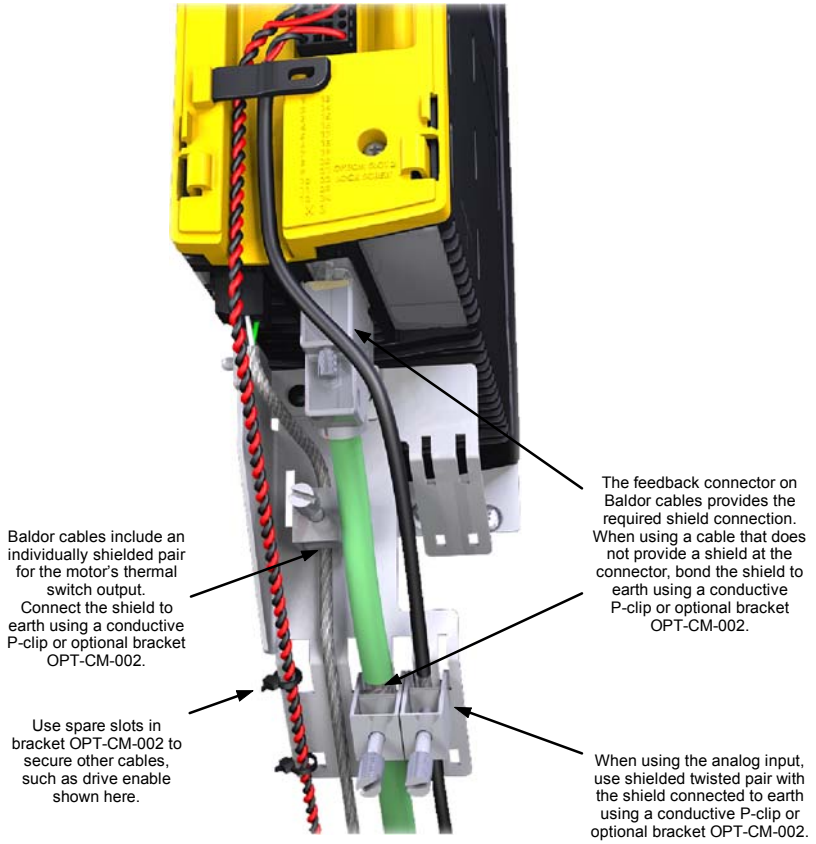

Baldor cables include an individually shielded pair for the motor's thermal switch output. Connect the shield to earth using a conductive P-clip or optional bracket OPT-CM-002.
Use spare slots in bracket OPT-CM-002 to secure other cables, such as drive enable shown here.
The feedback connector on Baldor cables provides the required shield connection. When using a cable that does not provide a shield at the connector, bond the shield to earth using a conductive P-clip or optional bracket OPT-CM-002.
When using the analog input, use shielded twisted pair with the shield connected to earth using a conductive P-clip or optional bracket OPT-CM-002.

Figure 20 - Bottom panel wiring using OPT-CM-002 / -003

3.8 Regeneration resistor (Dynamic Brake resistor)

Location	Connector X1 (top panel)
Mating connector	
1.5 A ~ 16 A models	Phoenix POWER COMBICON PC 4/ 5-ST-7,62)
21 A ~ 33 A models	Phoenix POWER COMBICON IPC 16/ 2-ST-10,16)
48 A ~ 65 A models	Phoenix POWER COMBICON ISPC 16/ 2-ST-10,16)

Electrical shock hazard. DC bus voltages may be present at these terminals. Use a suitable heatsink (with fan if necessary) to cool the regeneration resistor. The regeneration resistor and heatsink (if present) can reach temperatures in excess of 80 °C (176 °F).

An optional regeneration resistor may be required to dissipate excess power from the DC bus during motor deceleration. Care should be taken to select the correct resistor for the application - see section 3.9. Suitable resistors are are listed in section A.1.4. The regeneration resistor output is fully short-circuit proof according to EN61800-5-1, 6.2.

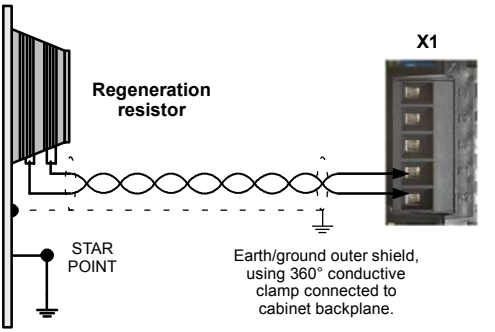

X1
Regeneration resistor
STAR POINT
Earth/ground outer shield, using 360° conductive clamp connected to cabinet backplane.

Figure 21 - Regeneration resistor connections - 1.5 A ~ 16 A models

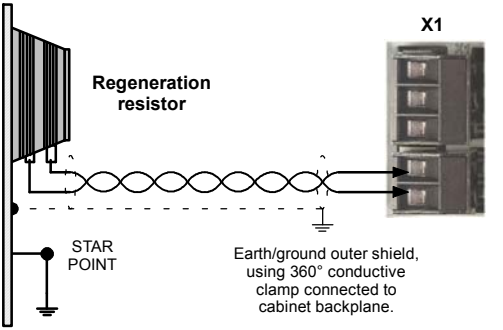

X1
Regeneration resistor
STAR POINT
Earth/ground outer shield, using 360° conductive clamp connected to cabinet backplane.

Figure 22 - Regeneration resistor connections - 21 A ~ 65 A models

For 1.5 A ~ 16 A models, tightening torque for X1 terminal block connections is 0.5-0.6 N·m (4.4-5.3 lb-in). The 48 A ~ 65 A models use a spring cage connector.

3.8.1 Regeneration capacity

The regeneration capacity of the MotiFlex *e*100 can be calculated from the following formula:

$$E = 0.5 \times \textit{DC bus capacitance} \times \left((\textit{Regen switching threshold})^2 - \left(\sqrt{2} \times \textit{Supply voltage} \right)^2 \right)$$

where the *Regen switching threshold* is 800 V. This gives the following typical values:

MotiFlex *e*100 catalog number	DC bus capacitance (µF)	Regeneration capacity (J)	
		230 VAC supply	480 VAC supply
MFE460A001	235	63	21
MFE460A003	235	63	21
MFE460A006	470	126	42
MFE460A010	470	126	42
MFE460A016	705	188	63
MFE460A021	960	256	86
MFE460A026	1280	342	115
MFE460A033	1280	342	115
MFE460A048	1350	360	121
MFE460A065	1350	360	121

Table 5 - Regeneration capacity

3.9 Regeneration resistor selection

The following calculations can be used to estimate the type of regeneration resistor that will be required for the application.

3.9.1 Required information

To complete the calculation, some basic information is required. Remember to use the worst-case figures to ensure that the regeneration power is not underestimated. For example, use the maximum possible motor speed, maximum inertia, minimum deceleration time and minimum cycle time that the application might encounter.

Requirement	Enter value here
a) Initial motor speed, before deceleration begins, in radians per second. *Multiply RPM by 0.1047 to give radians per second.*	**Initial motor speed, U = _____ rad/s**
b) Final motor speed after deceleration is complete, in radians per second. *Multiply RPM by 0.1047 to get radians per second. This value will be zero if the load is going to be stopped.*	**Final motor speed, V = _____ rad/s**
c) The deceleration time from initial speed to final speed, in seconds. See section 3.9.7.	**Decel time, D = _____ s**
d) The total cycle time (i.e. how frequently the process is repeated), in seconds. See section 3.9.7.	**Cycle time, C = _____ s**
e) Total inertia. *This is the total inertia seen by the drive, accounting for motor inertia, load inertia and gearing. Use the Mint WorkBench Autotune tool to tune the motor, with the load attached, to determine the value. This will be displayed in kg·m^2 in the Autotune tool. If you already know the motor inertia (from the motor spec.) and the load inertia (by calculation) insert the total here.* *Multiply kg·cm^2 by 0.0001 to give kg·m^2.* *Multiply lb-ft^2 by 0.04214 to give kg·m^2.* *Multiply lb-in-s^2 by 0.113 to give kg·m^2.*	**Total inertia, J = _____ kg·m^2**

3.9.2 Regenerative energy

The regenerative energy to be dissipated, E, is the difference between the initial energy in the system (before deceleration begins) and the final energy in the system (after deceleration has finished). If the system is brought to rest then the final energy is zero.

The energy of a rotating object is given by the formula:

$$E = \frac{1}{2} \times J \times \omega^2$$

where E is energy, J is the moment of inertia, and ω is the angular velocity.

The regenerative energy, which is the difference between the initial energy and the final energy, is therefore:

$$E = \left(\frac{1}{2} \times J \times U^2\right) - \left(\frac{1}{2} \times J \times V^2\right)$$

$$= \frac{1}{2} \times J \times (U^2 - V^2)$$

$$= \_\_\_\_\_ \textbf{ J (joules)}$$

Calculate E using the values for J, U and V entered in section 3.9.1. If E is less than the drive's regeneration capacity, shown in Table 5 on page 3-37, a regeneration resistor will not be required.

If E is greater than the drive's regeneration capacity, then continue to section 3.9.3 to calculate the regenerative and average power dissipation.

3.9.3 Regenerative power and average power

The regenerative power, P_r , is the *rate* at which the braking energy is dissipated. This rate is defined by the deceleration period, D. The shorter the deceleration period, the greater the regenerative power.

$$P_r = \frac{E}{D}$$

$$= \_\_\_\_\_ \textbf{ W (watts)}$$

Although the resistors shown in Table 6 can withstand brief overloads, the average power dissipation, P_{av}, must not exceed the stated power rating. The average power dissipation is determined by the proportion of the application cycle time spent regenerating. The greater the proportion of time spent regenerating, the greater the average power dissipation.

$$P_{av} = P_r \times \frac{D}{C}$$

$$= \_\_\_\_\_ \textbf{ W (watts)}$$

3.9.4 Resistor choice

P_{av} is the value to use when assessing which regeneration resistor to use. However, a safety margin of 1.25 times is recommended to ensure the resistor operates well within its limits*, so:

Required resistor power rating $= 1.25 \times P_{av}$

$=$ _____ **W (watts)**

The range of suitable regeneration resistors for each MotiFlex *e*100 model is shown in Table 6. Choose the resistor that has a power rating equal to or greater than the value calculated above. The resistance must be not be less than the minimum resistance stated for the particular MotiFlex *e*100 model.

MotiFlex *e*100 catalog number	Minimum resistance		Suitable resistors (spec = Baldor part)
	Single stand-alone drive	Sharing DC bus, or duty > 0.2	
MFE460A001	60 Ω	150 Ω	60 Ω, 100 W = RGJ160 60 Ω, 200 W = RGJ260 60 Ω, 300 W = RGJ360 150 Ω, 100 W = RGJ1150 150 Ω, 200 W = RGJ2150 150 Ω, 300 W = RGJ3150
MFE460A003			
MFE460A006			
MFE460A010	33 Ω	68 Ω	33 Ω, 500 W = RGJ533 68 Ω, 300 W = RGJ368
MFE460A016			
MFE460A021	15 Ω	60 Ω	15 Ω, 500 W = RGJ515 60 Ω, 300 W = RGJ360
MFE460A026			
MFE460A033			
MFE460A048	7.5 Ω	33 Ω	10 Ω, 1.2 kW = RGA1210 10 Ω, 2.4 kW = RGA2410 10 Ω, 4.8 kW = RGA4810
MFE460A065			

Table 6 - Regeneration resistors

***** The regeneration resistors listed in Table 6 can withstand a brief overload of 10 times the rated power for 5 seconds.

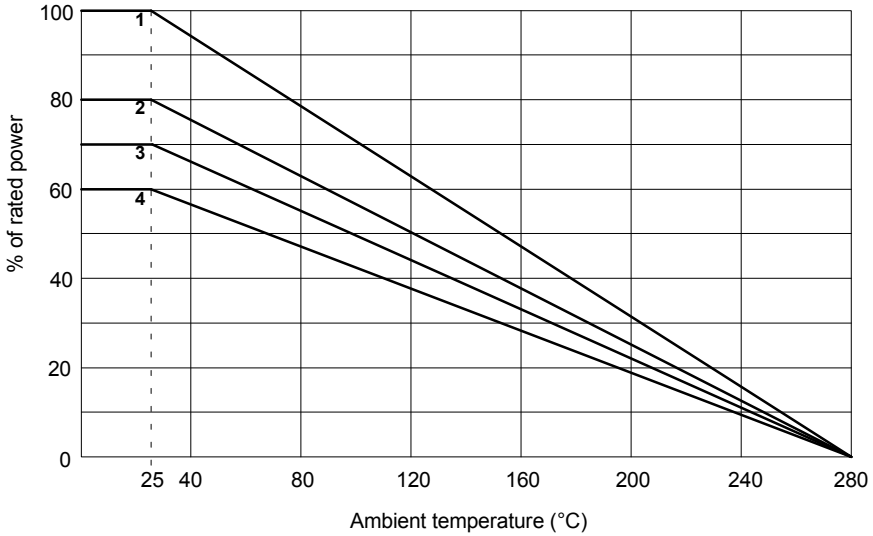
Note that a greater minimum resistance is specified when sharing the DC bus or using regeneration duty cycles greater than 0.2. This is because the drive to which the resistor is connected will be required to switch the regeneration energy from all of the shared drives. The shared drives could regenerate at different times, causing a greatly increased effective duty cycle (see section 3.9.7). Alternatively, several drives could regenerate at the same time, causing large peaks in regeneration energy. The greater minimum resistance allows for this extra loading and provides protection for the host drive's regeneration output circuitry.

Optionally, additional regeneration resistors may be connected to other drives in the group. Since all MotiFlex *e*100 drives have approximately the same regeneration threshold voltage, regeneration energy in the system will be shared proportionally (according to resistance) between all drives fitted with a regeneration resistor. Each resistor must still meet the *Sharing DC bus or duty > 0.2* requirement, listed in Table 6, for the drive to which it is fitted.

3.9.5 Resistor temperature derating

The RGJ... regeneration resistors shown in Table 6 can achieve their stated power rating only when mounted on a heatsink. In free air a derating must be applied. Furthermore, in ambient temperatures greater than 25 °C (77 °F), a temperature derating must be applied - see Figure 23.

The RGA... regeneration resistors shown in Table 6 must operate in ambient temperatures not exceeding 80°C (176°F). The resistor should be mounted vertically, as shown in section A.1.4. If mounted in any other position, its power rating must be derated by 35%.



1 On heatsink: all models.
2 Free air: RGJ160, RGJ1150.
3 Free air: RGJ260, RGJ2150, RGJ3150, RGJ360, RGJ368.
4 Free air: RGJ515, RGJ533.

Typical heatsinks (metal plate):
RGJ160, RGJ1150: 200 mm x 200 mm x 3 mm
All other RGJ models: 400 mm x 400 mm x 3 mm

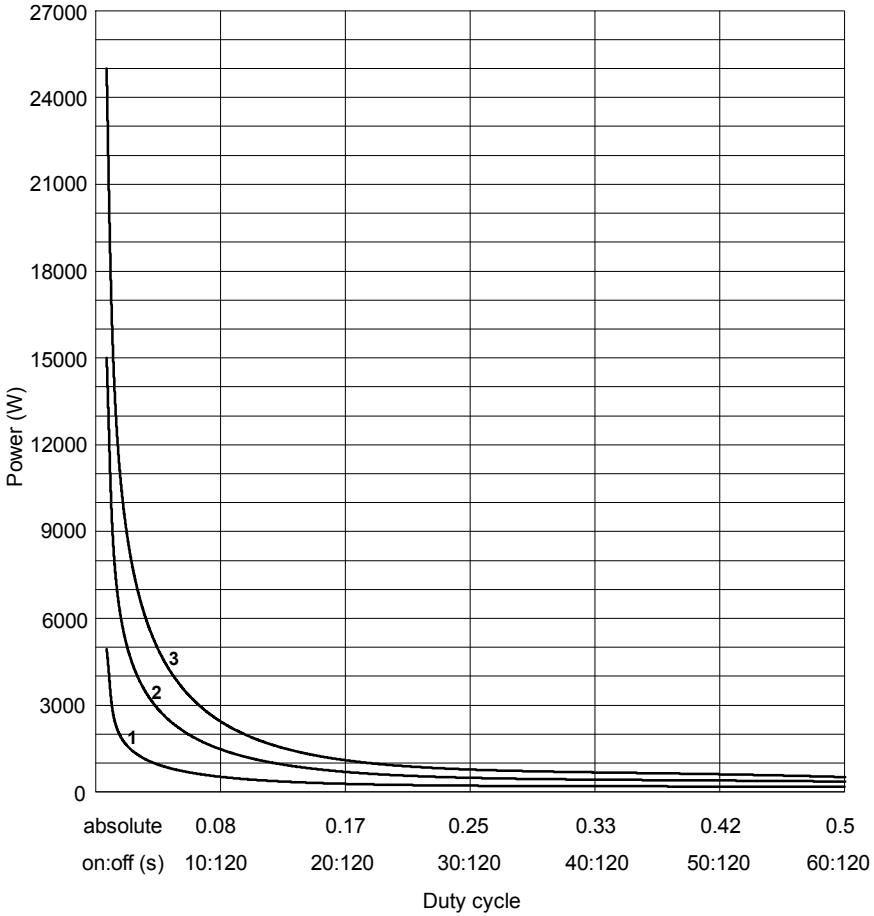
Figure 23 - Regeneration resistor temperature derating

WARNING

The RGJ... regeneration resistors listed here do not provide a fail-safe safety mechanism. For safety reasons and UL compliance, they will become open-circuit in the event of failure. This will cause the MotiFlex *e*100 to trip due to overvoltage, leaving the motor in an uncontrolled state. Further safety mechanisms such as a motor brake will be required, especially for applications involving suspended or tensioned loads.

3.9.6 Resistor pulse load rating

The regeneration resistors shown in Table 6 can dissipate power levels greater than the stated continuous power rating, provided the duty cycle (see section 3.9.7) is reduced, as shown in Figure 24.



1 100 W models: Maximum pulse 5 kW for 1 s, 120 s off.
2 300 W models: Maximum pulse 15 kW for 1 s, 120 s off.
3 500 W models: Maximum pulse 25 kW for 1 s, 120 s off.

Figure 24 - Regeneration resistor pulse load rating

3.9.7 Duty cycle

The regeneration duty cycle is the amount of time taken regenerating as a proportion of the overall application cycle time. For example, Figure 25 shows a system which performs a trapezoidal move profile, with regeneration during part of the deceleration phase. The regeneration duty is 0.2 (0.5 second regeneration / 2.5 second cycle time):

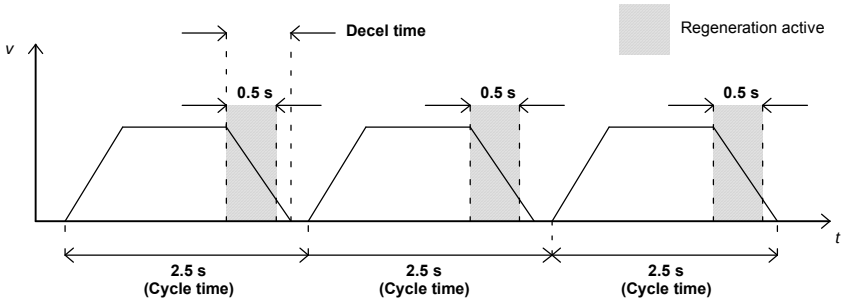


Figure 25 - Duty cycle = 0.2

4.1 Introduction

MotiFlex *e*100 supports many feedback options for use with linear and rotary motors, including incremental encoder, encoder with BiSS (Bi-directional Synchronous Serial interface), encoder with SSI (Synchronous Serial Interface), EnDat absolute encoder or SinCos encoder. All suitable types of feedback device can be connected to the universal feedback interface available on connector X8 (bottom panel).

There are some important considerations when wiring the feedback device:

- The feedback device wiring must be separated from power wiring. The MotiFlex *e*100 has been designed so that motor feedback wiring enters the bottom panel of the drive, well away from the AC power wiring entering the top panel.
- Where feedback device wiring runs parallel to power cables, they must be separated by at least 76 mm (3 in)
- Feedback device wiring must cross power wires at right angles only.
- To prevent contact with other conductors or earths/grounds, unearthed/ungrounded ends of shields must often be insulated.
- Linear motors may use two separate cables (encoder and Hall). The cores of these two cables will need to be wired to the appropriate pins of the 15-pin D-type mating connector.
- The inputs are not isolated.
- Baldor cables are recommended (see Appendix A). If alternative cables are used they must be of an equivalent specification.

4.1.1 Incremental encoder interface

The incremental encoder connections (ABZ channels and Hall signals) are made using the 15-pin D-type female connector X8. The encoder inputs (CHA, CHB and CHZ) accept differential signals only. Twisted pairs must be used for each complementary signal pair e.g. CHA+ and CHA-. The Hall inputs may be used as differential inputs (recommended for improved noise immunity) or single ended inputs. When used as single ended inputs, leave the Hall U-, Hall V- and Hall W- pins unconnected. The overall cable shield (screen) must be connected to the metallic shell of the D-type connector. Connector X8 includes a 'Sense' pin, which is used to detect the voltage drop on long cable runs. This allows the MotiFlex *e*100 to increase the encoder supply voltage on pin 12 to maintain a 5 VDC supply at the encoder (200 mA max).

Pin	Incremental encoder function
1	CHA+
2	CHB+
3	CHZ+
4	Sense
5	Hall U-
6	Hall U+
7	Hall V-
8	Hall V+
9	CHA-
10	CHB-
11	CHZ-
12	+5V out
13	DGND
14	Hall W-
15	Hall W+

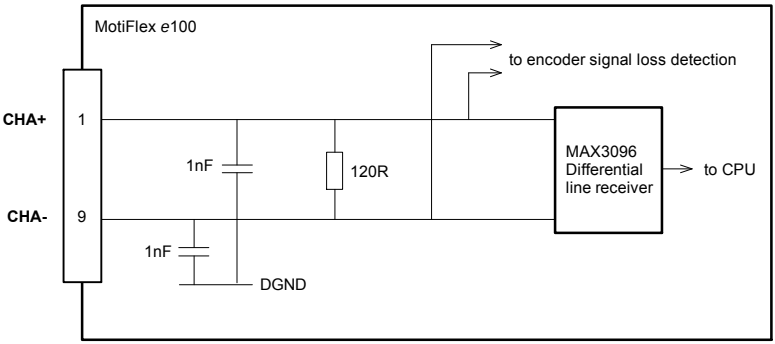


Figure 26 - Encoder channel input circuit - Channel A shown

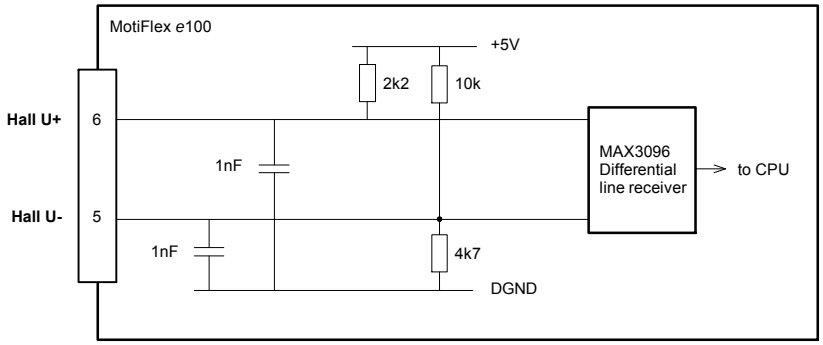


Figure 27 - Hall channel input circuit - U phase shown

4.1.1.1 Encoder cable configuration - Baldor rotary motors

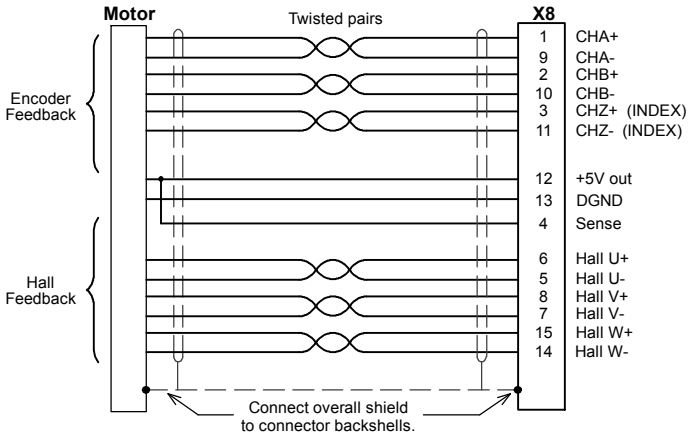


Figure 28 - Encoder cable connections - rotary motors

Note: If the Hall inputs are used as single ended inputs, leave the Hall U-, Hall V- and Hall W- pins unconnected; do not connect them to ground.

4.1.1.2 Encoders without Halls

Incremental encoders without Hall feedback connections may be connected to the MotiFlex *e*100. However, if Hall connections are not present, it will be necessary for the MotiFlex *e*100 to perform an automatic phase search sequence the first time it is enabled after power up. This will cause motor movement of up to 1 turn on rotary motors, or one pole-pitch on linear motors.

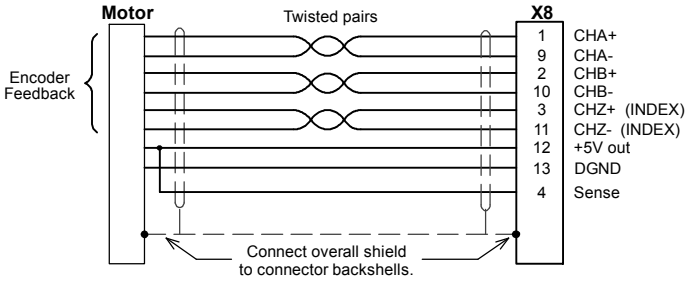


Figure 29 - Encoder cable connections without halls - rotary motors

4.1.1.3 Halls-only feedback devices

Feedback devices using only Hall sensors may be connected to the MotiFlex *e*100. However, since there are no encoder connections, the MotiFlex *e*100 will not be able to perform smooth speed control or accurate positioning control.

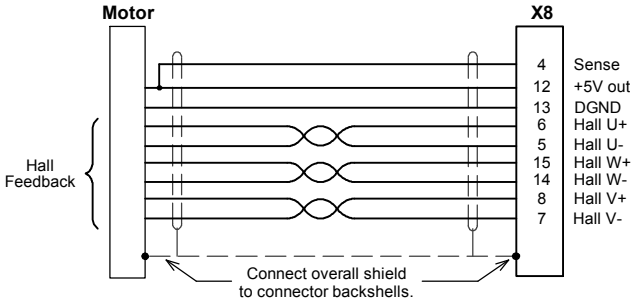


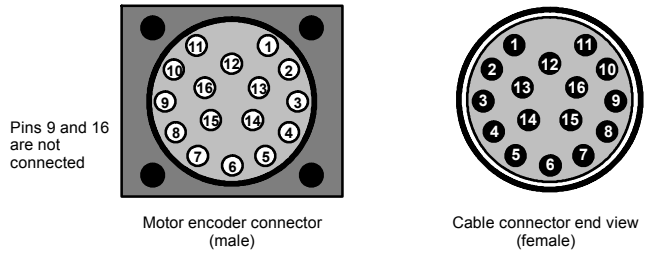
Figure 30 - Halls-only feedback cable connections - rotary motors

Note: If the Hall inputs are used as single ended inputs, leave the Hall U-, Hall V- and Hall W- pins unconnected; do not connect them to ground.

4.1.1.4 Encoder cable pin configuration - rotary motors

Figure 31 shows the pin configuration for a typical Baldor encoder feedback cable, part number CBL025SF-E2.

Signal name	MotiFlex *e*100 X8 pin	Motor / cable pin	Baldor encoder cable internal wire colors
CHA+	1	3	Purple
CHA-	9	4	Purple / White
CHB+	2	5	Green
CHB-	10	6	Green / White
CHZ+	3	7	Brown
CHZ-	11	8	Brown / White
Hall U+	6	10	Pink
Hall U-	5	11	Pink / Black
Hall V+	8	12	Yellow
Hall V-	7	13	Yellow / Black
Hall W+	15	14	Grey
Hall W-	14	15	Grey / Black
+5V	12	1	Red
DGND	13	2	Blue



Motor encoder connector (male)

Cable connector end view (female)

Figure 31 - Baldor rotary motor encoder cable pin configuration

The maximum recommended cable length is 30.5m (100ft).

4.1.1.5 Encoder cable pin configuration - Baldor linear motors

Baldor linear motors use two separate cables (encoder and Hall). The cores of these two cables must be wired to the appropriate pins of the 15-pin D-type mating connector (supplied):

Signal name	MotiFlex *e*100 X8 pin	Encoder cable internal wire colors
CHA+	1	Please refer to MN1800 *Linear Motors Installation & Operating Manual* for details.
CHA-	9	
CHB+	2	
CHB-	10	
CHZ+	3	
CHZ-	11	
		Baldor Hall cable internal wire colors
Hall U+	6	White
Hall V+	8	Red
Hall W+	15	Black
+5V out	12	Brown
Hall GND	13	Green

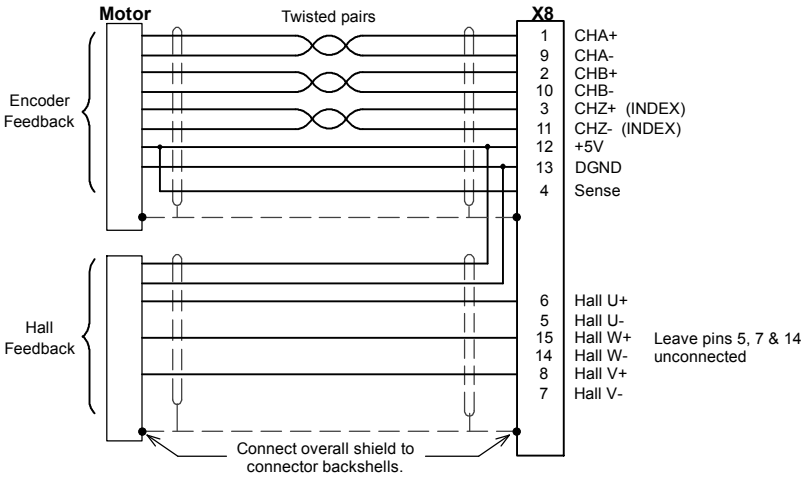


Figure 32 - Encoder cable connections - linear motors

4.1.2 BiSS interface

The BiSS (Bi-directional Serial Synchronous interface) is an open-source interface that can be used with many types of absolute encoder. The BiSS interface connections are made using the 15-pin D-type female connector X8. Twisted pair cables must be used for the complementary signal pairs e.g. Data+ and Data-. The overall cable shield (screen) must be connected to the metallic shell of the D-type connector. Connector X8 includes a 'Sense' pin, which is used to detect the voltage drop on long cable runs. This allows the MotiFlex *e*100 to increase the supply voltage on pin 12 to maintain a 5 VDC supply at the encoder (200 mA max).

Pin	BiSS function	
1	Data+	
2	Clock+	
3	*(NC)*	
4	Sense	
5	*Sin-*	Note: If your cable has Sin and Cos pairs they may be connected here. However, these signals are not required or used by the MotiFlex *e*100 for BiSS operation.
6	*Sin+*	
7	*Cos-*	
8	*Cos+*	
9	Data-	
10	Clock-	
11	*(NC)*	
12	+5V out	
13	DGND	
14	*(NC)*	
15	*(NC)*	

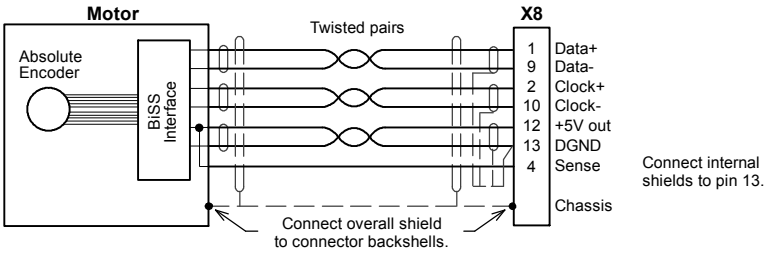
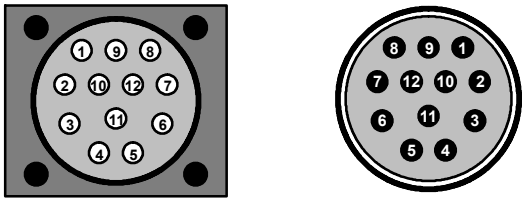


Figure 33 - BiSS interface cable connections

4.1.2.1 BiSS interface cable pin configuration

Figure 40 shows the pin configuration for a typical Baldor BiSS feedback cable, part number CBL025SF-D2.

Signal name	MotiFlex *e*100 X8 pin	Motor / cable pin	Baldor BiSS / EnDat / SinCos cable internal wire colors
Data-	9	1	Brown / White
Clock-	10	5	Pink / Black
Clock+	2	7	Pink
Sense	4	9	Orange
+5V out	12	9	Red
DGND	13	10	Blue
Data+	1	12	Brown



Motor BiSS interface connector (male)

Cable connector end view (female)

Figure 34 - Baldor rotary motor BiSS interface pin configuration

The maximum recommended cable length is 30.5 m (100 ft).

4.1.3 SSI interface

The SSI (Synchronous Serial Interface) is specifically designed for use with Baldor SSI motors, which incorporate a custom Baumer SSI encoder. Correct operation with other SSI interfaces cannot be guaranteed. The SSI interface connections are made using the 15-pin D-type female connector X8. Twisted pair cables must be used for the complementary signal pairs e.g. Data+ and Data-. The overall cable shield (screen) must be connected to the metallic shell of the D-type connector. Connector X8 includes a 'Sense' pin, which is used to detect the voltage drop on long cable runs. This allows the MotiFlex *e*100 to increase the supply voltage on pin 12 to maintain a 5 VDC supply at the encoder (200 mA max).

Pin	SSI function	
1	Data+	
2	Clock+	
3	*(NC)*	
4	Sense	
5	*Sin-*	Note: If your cable has Sin and Cos pairs they may be connected here. However, these signals are not required or used by the MotiFlex *e*100 for SSI operation.
6	*Sin+*	
7	*Cos-*	
8	*Cos+*	
9	Data-	
10	Clock-	
11	*(NC)*	
12	+5V out	
13	DGND	
14	*(NC)*	
15	*(NC)*	

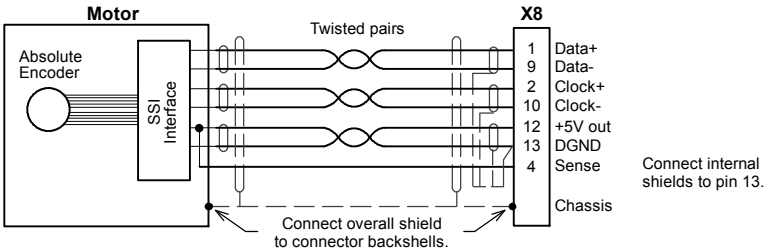


Figure 35 - SSI interface cable connections

4.1.3.1 SSI cable pin configuration

Figure 36 shows the pin configuration for a typical Baldor SSI feedback cable, part number CBL025SF-S2

Signal name	MotiFlex *e*100 X8 pin	Motor / cable pin	Baldor SSI cable internal wire colors
+5V out	12	1	Red
Sense	4	9	Orange
DGND	13	2	Blue
Clock+	2	3	Green
Clock-	10	4	Yellow
Data+	1	5	Pink
Data-	9	6	Grey

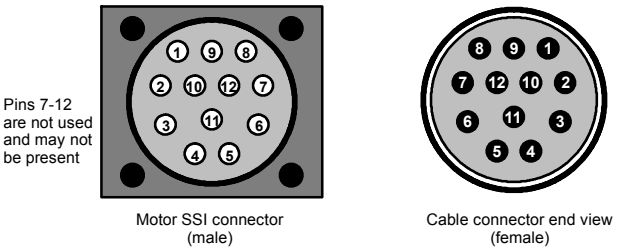


Figure 36 - Baldor rotary motor SSI interface pin configuration

The maximum recommended cable length is 30.5 m (100 ft).

4.1.4 SinCos interface

The SinCos interface connections (Sin and Cos incremental channels only) are made using the 15-pin D-type female connector X8. Twisted pair cables must be used for the complementary signal pairs e.g. Sin+ and Sin-. The overall cable shield (screen) must be connected to the metallic shell of the D-type connector. Connector X8 includes a 'Sense' pin, which is used to detect the voltage drop on long cable runs. This allows the MotiFlex *e*100 to increase the supply voltage on pin 12 to maintain a 5 VDC supply at the encoder (200 mA max). The Sin and Cos channel input circuits accept a nominal 1 V pk-pk sine wave centered on a 2.5 V reference.

Pin	SinCos function
1	*(NC)*
2	*(NC)*
3	*(NC)*
4	Sense
5	Sin-
6	Sin+
7	Cos-
8	Cos+
9	*(NC)*
10	*(NC)*
11	*(NC)*
12	+5V out
13	DGND
14	*(NC)*
15	*(NC)*

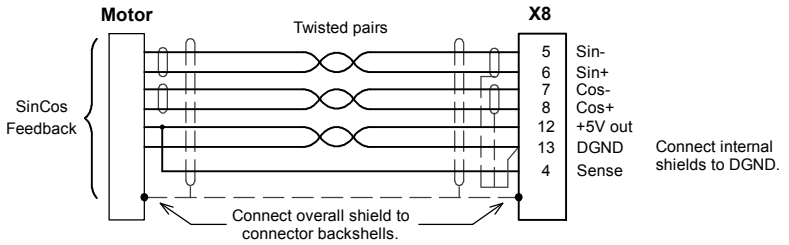
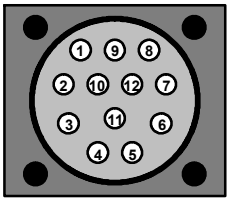


Figure 37 - SinCos interface cable connections

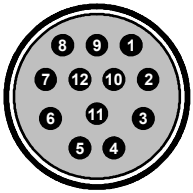
4.1.4.1 SinCos cable pin configuration

Figure 38 shows the pin configuration for a typical Baldor SinCos feedback cable, part number CBL025SF-D2.

Signal name	MotiFlex *e*100 X8 pin	Motor / cable pin	Baldor BiSS / EnDat / SinCos cable internal wire colors
(Not used)	9	1	Brown / White
Sin+	6	2	Green
Cos+	8	4	Purple
(Not used)	10	5	Pink / Black
(Not used)	2	7	Pink
Cos-	7	8	Purple / White
Sense	4	9	Orange
+5V out	12	9	Red
DGND	13	10	Blue
Sin-	5	11	Green / White
(Not used)	1	12	Brown



Motor SinCos connector (male)



Cable connector end view (female)

Figure 38 - Baldor rotary motor SinCos interface pin configuration

The maximum recommended cable length is 30.5 m (100 ft).

4.1.5 EnDat interface

The EnDat interface supports both incremental and absolute (multi and single turn) feedback using EnDat technology. It is possible to read and write information to the encoder. The EnDat interface connections are made using the 15-pin D-type female connector X8. Twisted pair cables must be used for the complementary signal pairs e.g. Sin+ and Sin-. The overall cable shield (screen) must be connected to the metallic shell of the D-type connector. Connector X8 includes a 'Sense' pin, which is used to detect the voltage drop on long cable runs. This allows the MotiFlex *e*100 to increase the supply voltage on pin 12 to maintain a 5 VDC supply at the encoder (200 mA max). The Sin and Cos channel input circuits accept a nominal 1 V pk-pk sine wave centered on a 2.5 V reference. Version 2.2 EnDat encoders do not use the Sin and Cos channels.

Pin	EnDat function
1	Data+
2	Clock+
3	*(NC)*
4	Sense
5	Sin-
6	Sin+
7	Cos-
8	Cos+
9	Data-
10	Clock-
11	*(NC)*
12	+5V out
13	DGND
14	*(NC)*
15	*(NC)*

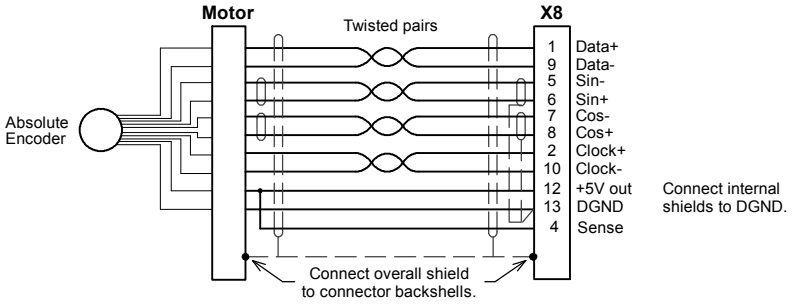
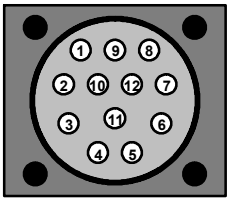


Figure 39 - EnDat interface cable connections

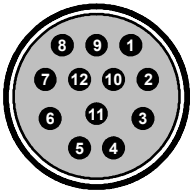
4.1.5.1 EnDat interface cable pin configuration

Figure 40 shows the pin configuration for a typical Baldor EnDat feedback cable, part number CBL025SF-D2.

Signal name	MotiFlex *e*100 X8 pin	Motor / cable pin	Baldor BiSS / EnDat / SinCos cable internal wire colors
Data-	9	1	Brown / White
Sin+	6	2	Green
Cos+	8	4	Purple
Clock-	10	5	Pink / Black
Clock+	2	7	Pink
Cos-	7	8	Purple / White
Sense	4	9	Orange
+5V out	12	9	Red
DGND	13	10	Blue
Sin-	5	11	Green / White
Data+	1	12	Brown



Motor EnDat connector (male)



Cable connector end view (female)

Figure 40 - Baldor rotary motor EnDat cable pin configuration

The maximum recommended cable length is 30.5 m (100 ft).

5.1 Introduction

This section describes the various digital input and output capabilities of the MotiFlex *e*100, with descriptions of each of the connectors on the front panel.

The following conventions are used to refer to the inputs and outputs:

I/O . . . . . Input / Output
AIN . . . . . Analog Input
DIN . . . . . Digital Input
DOUT . . . . . Digital Output

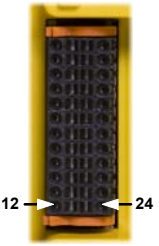
In the following sections, all connections to X2 and X3 assume stranded copper wire is used with a temperature rating of at least 70 °C (158 °F). Use copper conductors only.

5.2 Analog I/O

The MotiFlex *e*100 provides as standard:

- 1 analog input on the connector block X3 (demand input)

5.2.1 Analog input - X3 (demand)



Location	Connector X3, pins 12 & 24 (Mating connector: Weidmüller Minimate B2L 3.5/24 LH)
Name	AIN0
Description	Single ended or differential input. Common mode voltage range: ±10 VDC. Resolution: 12-bit (accuracy ±4.9 mV) Common mode rejection: 40 dB Input impedance: >30 kΩ Sampling interval: 125 µs

The analog input can be connected as either a differential or a single ended input as shown in Figure 42. The analog input is not optically isolated from internal power rails, so care must be taken to avoid earth/ground loops and similar associated problems. The input buffers provide low pass filtering of the applied voltage. To minimize the effects of noise, the analog input signal should be connected to the system using an individually shielded twisted pair cable with an overall shield. The overall shield should be connected to the chassis at one end only. No other connection should be made to the shield.

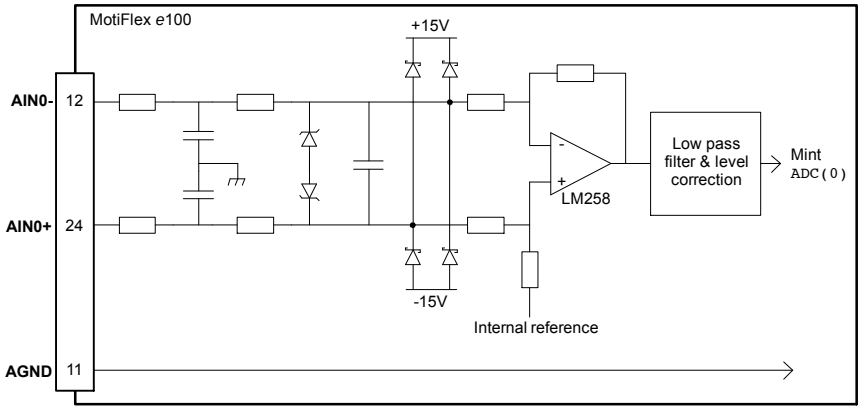


Figure 41 - AIN0 analog input (demand) circuit

When the MotiFlex *e*100 is connected to Mint WorkBench, the analog input value (expressed as a percentage) can be viewed using the Spy window's Monitor tab. Alternatively, the command `Print ADC(0)` can be used in the command window to return the value of the analog input. See the Mint help file for details.

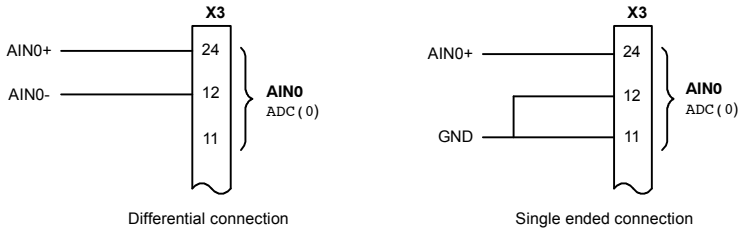


Figure 42 - AIN0 analog input wiring

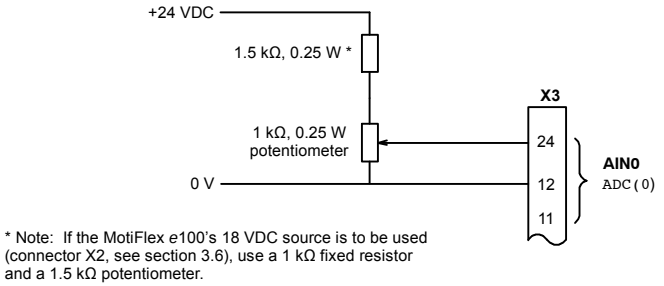

+24 VDC
1.5 kΩ, 0.25 W *
1 kΩ, 0.25 W
potentiometer
0 V
X3
24
12
11
AIN0
ADC (0)
* Note: If the MotiFlex e100's 18 VDC source is to be used (connector X2, see section 3.6), use a 1 kΩ fixed resistor and a 1.5 kΩ potentiometer.

Figure 43 - Typical input circuit to provide 0-10 V (approx.) input from a 24 V source

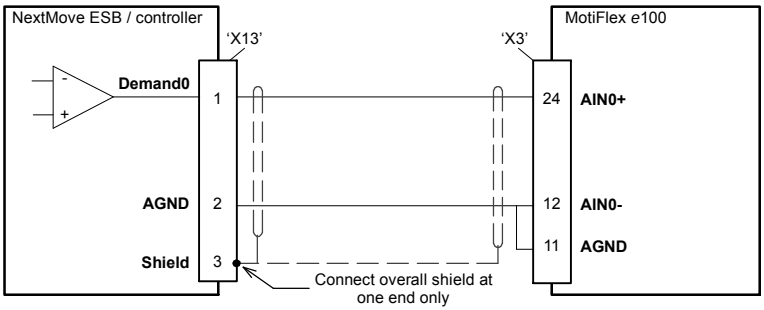


Figure 44 - Analog input - typical connection from a Baldor NextMove ESB

5.3 Digital I/O

The MotiFlex *e*100 provides as standard:

- 3 general purpose digital inputs.
- 1 dedicated drive enable input.
- 1 general purpose digital output.
- 1 general purpose / drive status output.
- 1 dedicated motor overtemperature trip input.

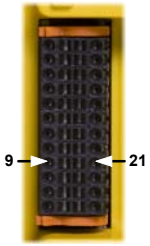
The general purpose digital inputs can be configured for typical input functions:

- Error input.
- Reset input.
- Stop input.
- Forward / reverse limit input.
- Home input - see important details in section 5.3.2.1 or 5.3.3.1.
- Power ready input (for DC bus sharing, see section 3.5.2).

The general purpose digital outputs can be configured for a variety of output functions:

- Drive enable indication.
- Global error indication.
- Motor brake output: controls the activation of the motor's brake.
- Compare output: indicates when the axis is within a specified position range.

5.3.1 Drive enable input



Location	Connector X3, pins 9 & 21 (Mating connector: Weidmüller Minimate B2L 3.5/24 LH)
Name	Drive enable
Description	Dedicated drive enable input. Nominal input voltage: 24 VDC (input current not to exceed 50 mA) Sampling interval: 1 ms

The drive enable input is buffered by a TLP280 opto-isolator, allowing the input signal to be connected with either polarity.

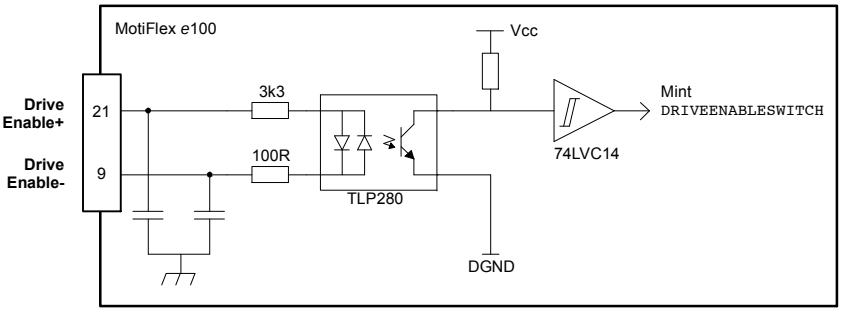


Figure 45 - Drive enable input circuit

The drive enable input must be active and there must be no errors present before the MotiFlex *e*100 can be enabled. Additional methods are required to enable the MotiFlex *e*100, depending on the currently selected control reference source. The control reference source can be selected on Mint WorkBench's Motion toolbar. See also section 6.4.4.8.

- If the control reference source is set to 'Direct', the Mint WorkBench drive enable button on the motion toolbar toggles the enable/disable status. Alternatively, the Mint command `DRIVEENABLE(0)=1` can be used in the command window to enable the MotiFlex *e*100; `DRIVEENABLE(0)=0` will disable the MotiFlex *e*100.
  The Tools, Reset Controller menu item will also clear errors and enable the MotiFlex *e*100. Alternatively, the Mint command `RESET(0)` can be used in the command window to perform the same action.
- If the control reference source is set to 'EPL' or 'CAN', the respective fieldbus master controls the drive enable status. Mint WorkBench cannot be used to control the drive enable status until the control mode has been changed back to 'Direct'.

The state of the drive enable input is displayed in the Mint WorkBench Spy window. Alternatively, the state of the drive enable input can be read (but not set) using the Mint command `Print DRIVEENABLESWITCH(0)` in the command window. See the Mint help file for details.

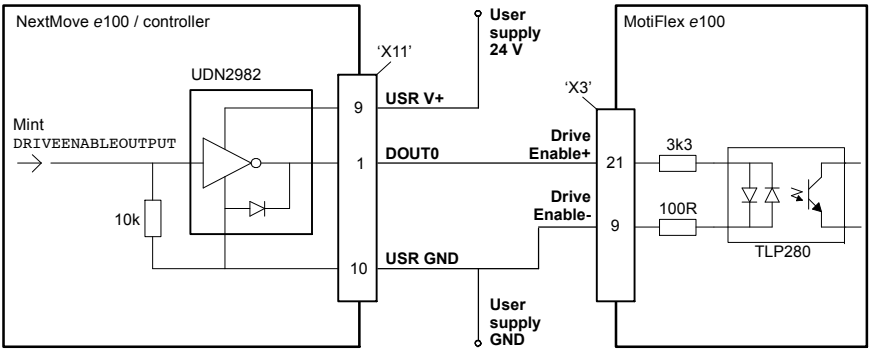
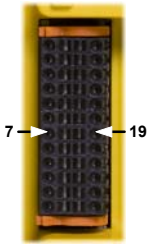


Figure 46 - Drive enable input - typical connection from a Baldor NextMove *e*100

5.3.2 General purpose digital input DIN0



Location	Connector X3, pins 7 & 19 (Mating connector: Weidmüller Minimate B2L 3.5/24 LH)
Name	DIN0
Description	General purpose opto-isolated digital input. Nominal input voltage: 24 VDC (input current not to exceed 50 mA) Sampling interval: 1 ms

This general purpose digital input is buffered by a TLP280 opto-isolator, allowing the input signal to be connected with either polarity. The state of the digital input is displayed in the Mint WorkBench Spy window. The input can be can be configured for different user definable functions.

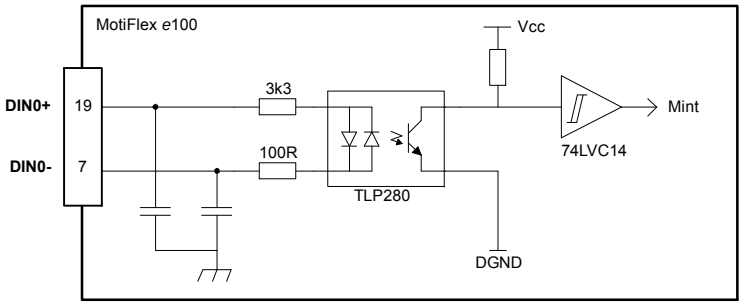


Figure 47 - General purpose digital input circuit

When the MotiFlex *e*100 is connected to Mint WorkBench, the digital input can be configured using the Digital I/O tool. Alternatively, Mint keywords including `RESETINPUT`, `ERRORINPUT`, `STOPINPUT`, `FORWARDLIMITINPUT`, `REVERSELIMITINPUT`, `POWERREADYINPUT` and `HOMEINPUT` can be used in the command window. The state of the digital input can be viewed using the Mint WorkBench Spy window's Axis tab. See the Mint help file for details.

5.3.2.1 Using a digital input as a home switch input

When the MotiFlex *e*100 is being controlled over EPL by a manager node (e.g. NextMove *e*100), the home switch input must be wired to the MotiFlex *e*100, not the manager node. This is because the manager node only *triggers* the homing sequence, which is then performed entirely by the MotiFlex *e*100. It is therefore the MotiFlex *e*100 which must receive the home switch input signal, otherwise it will not be able to complete its homing routine. Similarly, it is the MotiFlex *e*100's own `HOME`... keyword parameters that define the homing sequence.

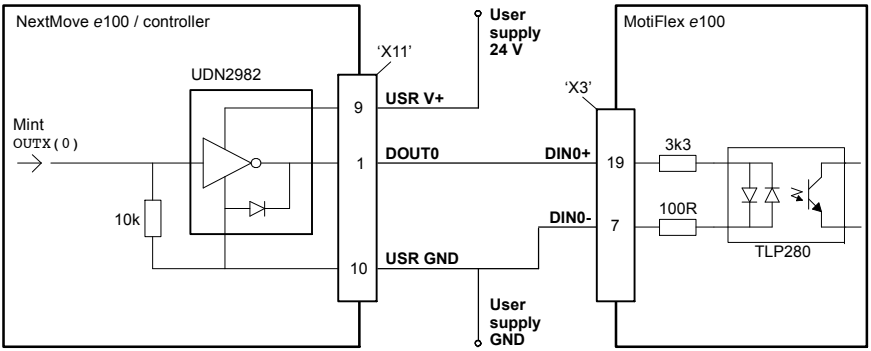
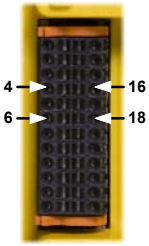


Figure 48 - Digital input - typical connection from a Baldor NextMove *e*100

5.3.3 General purpose digital inputs DIN1 & DIN2



Location	Connector X3, pins 6 & 18 (DIN1), 4 & 16 (DIN2) (Mating connector: Weidmüller Minimate B2L 3.5/24 LH)
Name	DIN1, DIN2
Description	General purpose fast opto-isolated digital inputs. Nominal input voltage: 24 VDC (input current not to exceed 20 mA) Maximum input frequency: 1 MHz maximum

These general purpose fast digital inputs are buffered by a TLP115 opto-isolator, allowing the input signal to be connected with either polarity. The state of the digital input is displayed in the Mint WorkBench Spy window. The inputs can be can be configured for different user definable functions.

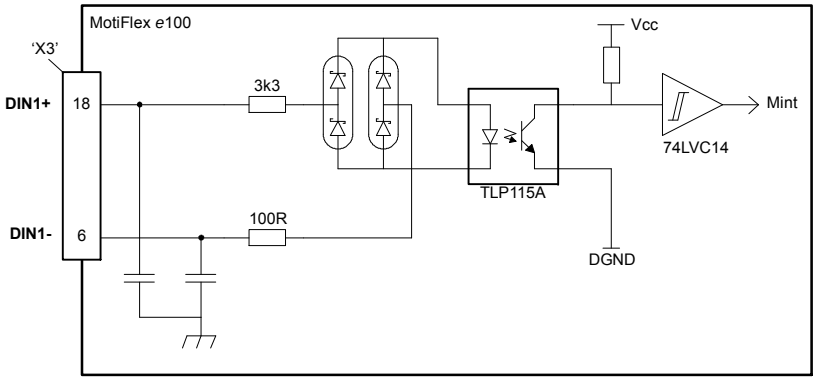


Figure 49 - General purpose fast digital input circuit

When the MotiFlex *e*100 is connected to Mint WorkBench, the digital input can be configured using the Digital I/O tool. Alternatively, Mint keywords including `RESETINPUT`, `ERRORINPUT`, `STOPINPUT`, `FORWARDLIMITINPUT`, `REVERSELIMITINPUT`, `POWERREADYINPUT` and `HOMEINPUT` can be used in the command window. The state of the digital input can be viewed using the Mint WorkBench Spy window's Axis tab. See the Mint help file for details.

5.3.3.1 Using a digital input as a home switch input

When the MotiFlex *e*100 is being controlled over EPL by a manager node (e.g. NextMove *e*100), the home switch input must be wired to the MotiFlex *e*100, not the manager node. This is because the manager node only *triggers* the homing sequence, which is then performed entirely by the MotiFlex *e*100. It is therefore the MotiFlex *e*100 which must receive the home switch input signal, otherwise it will not be able to complete its homing routine. Similarly, it is the MotiFlex *e*100's own `HOME`... keyword parameters that define the homing sequence.

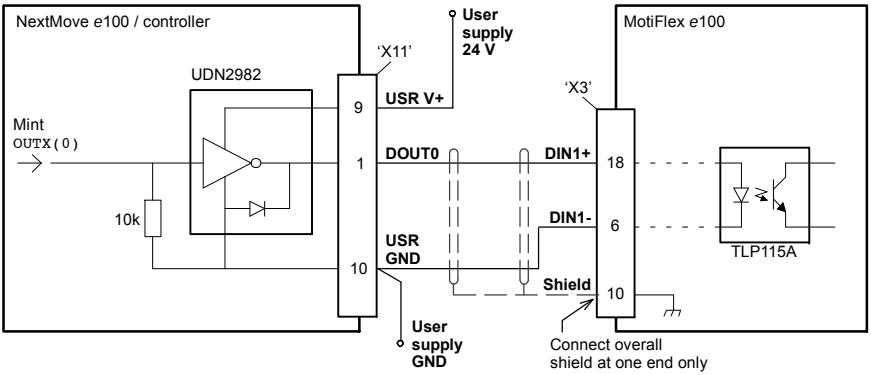


Figure 50 - Digital input - typical connection from a Baldor NextMove *e*100

5.3.4 Special functions on inputs DIN1 & DIN2

DIN1 and DIN2 can be configured to perform special functions.

5.3.4.1 Step (pulse) and direction inputs

Using the MASTERSOURCE keyword, the MotiFlex *e*100 can be configured to use DIN1 and DIN2 as step and direction inputs:

- DIN1 is used as the step input. The step frequency controls the speed of the motor.
- DIN2 is used as the direction input. The state of the direction input controls the direction of motion. An active input will result in forward motion. An inactive input will result in motion in the opposite direction.

5.3.4.2 Fast position capture

DIN1 or DIN2 can be configured using the LATCHTRIGGERCHANNEL keyword to become a fast latch input. This allows the position of the axis to be captured in real-time and read using the Mint keyword LATCHVALUE. The input can configured using the LATCHTRIGGEREDGE keyword to be triggered either on a rising or falling edge. Further control of position capture is provided by other keywords beginning with LATCH... . See the Mint help file for details.

The maximum latency to read the fast position depends on the feedback device. For an incremental encoder, the latency is approximately 150 - 300 ns. For other feedback devices latency may be up to 62.5 µs, resulting from the 16 kHz sampling frequency used for these types of feedback device. The fast interrupt will be latched on a pulse width of about 30 µs, although a width of 100 µs is recommended to ensure capture. To prevent subsequent inputs causing the captured value to be overwritten, the interrupt is latched in software.

Note: The fast inputs are particularly sensitive to noise, so inputs must use shielded twisted pair cable. Do not connect mechanical switches, relay contacts or other sources liable to signal 'bounce' directly to the fast inputs. This could cause unwanted multiple triggering.

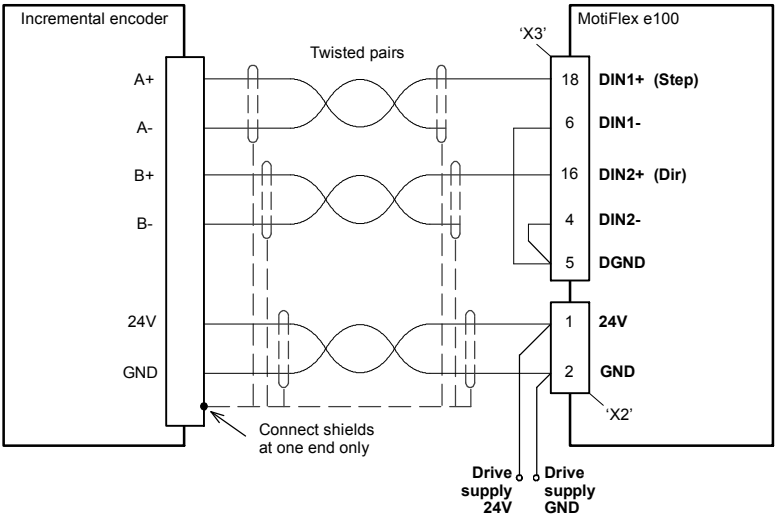


Figure 51 - Step and direction inputs - typical connection from an incremental encoder

Note: When using an incremental encoder source, do not connect the A- or B- outputs; leave them unconnected as shown in Figure 51.

5.3.5 Motor overtemperature input

Location	Connector X16 (bottom panel) (Mating connector: Phoenix COMBICON MSTBT 2,5/ 2-ST-5,08)
Name	Motor overtemperature switch in
Description	Dedicated motor overtemperature input. Trip: $R_{TH1-TH2}$ > 3.0 kΩ typ. (2.9 kΩ - 3.2 kΩ) Not tripped: $R_{TH1-TH2}$ < 2.8 kΩ typ. (2.7 kΩ - 3.0 kΩ) Sampling interval: Immediate

The motor overtemperature input is a dedicated input which may be directly connected to the motor's thermal switch. When the motor overheats and triggers the overtemperature input, the MotiFlex *e*100 is normally disabled.

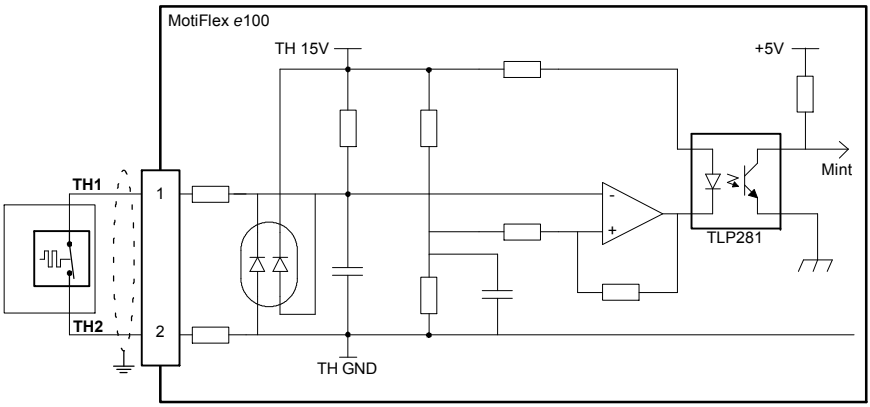


Figure 52 - Motor overtemperature input circuit

5.3.5.1 Connecting motors with normally closed switch contacts

Some motors contain a thermal switch with normally closed contacts. When the motor overheats the switch contacts open. For this type of motor, connect the switch contact outputs directly to TH1 and TH2, as shown in Figure 52.

5.3.5.2 Connecting motors with temperature dependent resistive output

Some motors contain a thermistor based resistive output. As the motor temperature increases, the resistance between the thermal output connections increases. For this type of motor, the thermal output connections may be connected directly to TH1 and TH2, but care must be taken to ensure that the resistance will be sufficient to trigger the MotiFlex *e*100's input circuit.

To ensure triggering of the input circuit, the resistance between TH1 and TH2 must exceed 3.2 kΩ. If the motor's thermistor does not achieve this resistance at the required trip temperature, it may be necessary to include an additional fixed resistor in the circuit, as shown in Figure 53. The total resistance must fall to less than 2.8 kΩ (typical) to re-enable the drive.

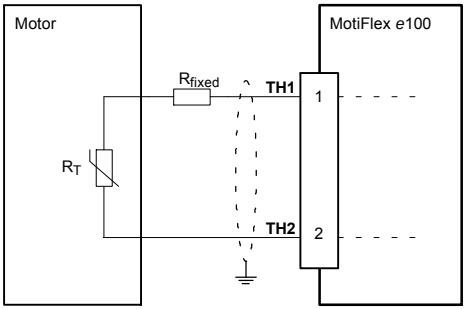

Motor
MotiFlex e100
Rfixed
TH1
1
RT
TH2
2
Example 1:
Motor maximum temp. = 130 °C
RT = 6 kΩ @ 130 °C
RT > 3.2 kΩ, so Rfixed not required.
Example 2:
Motor maximum temp. = 130 °C
RT = 2 kΩ @ 130 °C
Add Rfixed = 1.2 kΩ, so that RT + Rfixed >= 3.2 kΩ,
Note: To remove the trip, RT + Rfixed must reduce to less than 2.8 kΩ.

Figure 53 - Using a thermistor controlled motor overtemperature output

Use a shielded twisted pair for the motor temperature connection, with the overall cable shield (screen) connected to the metal backplane or signal cable management bracket (section A.1.6).

The state of the motor overtemperature input can be read using the `MOTORTEMPERATURESWITCH` keyword. The resulting behavior of the MotiFlex *e*100 can be controlled using the `MOTORTEMPERATUREMODE` keyword. See the Mint help file for details.

5.3.6 General purpose / status digital output DOUT0

Location	Connector X3, pins 1 & 13 (Mating connector: Weidmüller Minimate B2L 3.5/24 LH)
Name	Status / DOUT0
Description	General purpose opto-isolated digital output Output current: 100 mA maximum User supply 28 VDC maximum Update interval: 1 ms

The optically isolated general purpose / status output is designed to source current from the user supply as shown in Figure 54. The TLP 127 has a maximum power dissipation of 150 mW at 25 °C. The maximum saturated voltage across the outputs when active is 1.0 VDC, so it can be used as a TTL compatible output.

The output includes a self-resetting fuse that operates at approximately 200 mA. The fuse may take up to 20 seconds to reset after the load has been removed. If the output is used to directly drive a relay, a suitably rated diode must be fitted across the relay coil, observing the correct polarity. This is to protect the output from the back-EMF generated by the relay coil when it is de-energized. The sense of the output can be configured in Mint WorkBench, and its state is displayed in the Spy window.

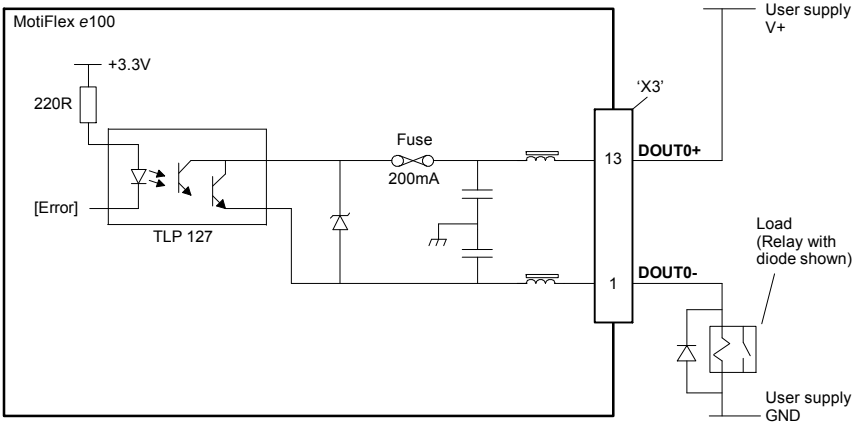


Figure 54 - DOUT0 output circuit

By default, DOUT0 is configured as an error status output, which becomes inactive in the event of an error. When the MotiFlex *e*100 is connected to Mint WorkBench, the active level of the output can be configured using the Digital I/O tool. Alternatively, the Mint keyword `OUTPUTACTIVELEVEL` can be used in the command window. Other Mint keywords such as `COMPAREOUTPUT`, `GLOBALERROROUTPUT`, `DRIVEENABLEOUTPUT` and `MOTORBRAKEOUTPUT` (see section 3.7.6) can also be used in the command window. The state of the digital output can be viewed using the Mint WorkBench Spy window's Axis tab. See the Mint help file for details.

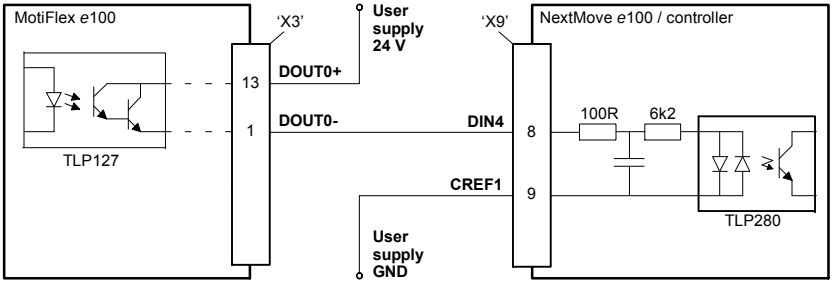
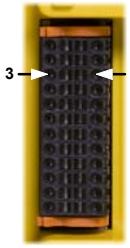


Figure 55 - DOUT0 - typical connections to a Baldor NextMove *e*100

5.3.7 General purpose digital output DOUT1



Location	Connector X3, pins 3 & 15 (Mating connector: Weidmüller Minimate B2L 3.5/24 LH)
Name	DOUT1
Description	General purpose opto-isolated digital output Output current: 100 mA maximum User supply: 28 VDC maximum Update interval: 1 ms

The optically isolated general purpose output is designed to source current from the user supply as shown in Figure 54. The TLP 127 has a maximum power dissipation of 150 mW at 25 °C. The maximum saturated voltage across the outputs when active is 1.0 VDC, so it can be used as a TTL compatible output.

The output includes a self-resetting fuse that operates at approximately 200 mA. The fuse may take up to 20 seconds to reset after the load has been removed. If the output is used to directly drive a relay, a suitably rated diode must be fitted across the relay coil, observing the correct polarity. This is to protect the output from the back-EMF generated by the relay coil when it is de-energized. The sense of the output can be configured in Mint WorkBench, and its state is displayed in the Spy window.

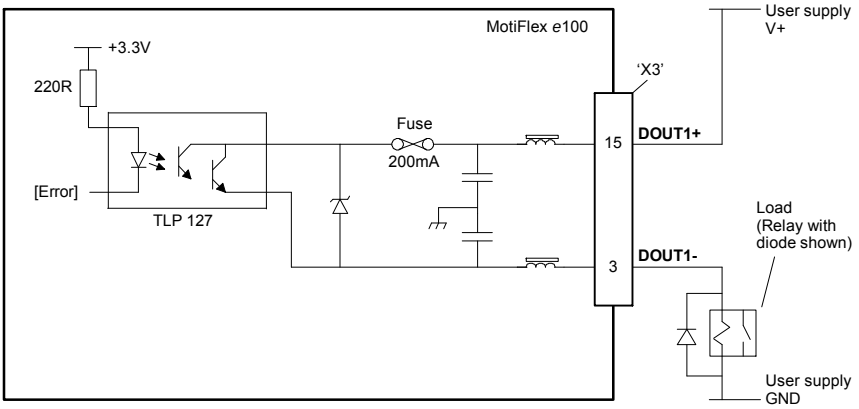


Figure 56 - DOUT1 output circuit

When the MotiFlex *e*100 is connected to Mint WorkBench, the active level of the output can be configured using the Digital I/O tool. Alternatively, the Mint keyword `OUTPUTACTIVELEVEL` can be used in the command window. Other Mint keywords such as `COMPAREOUTPUT`, `GLOBALERROROUTPUT`, `DRIVEENABLEOUTPUT` and `MOTORBRAKEOUTPUT` (see section 3.7.6) can also be used in the command window. The state of the digital output can be viewed using the Mint WorkBench Spy window's Axis tab. See the Mint help file for details.

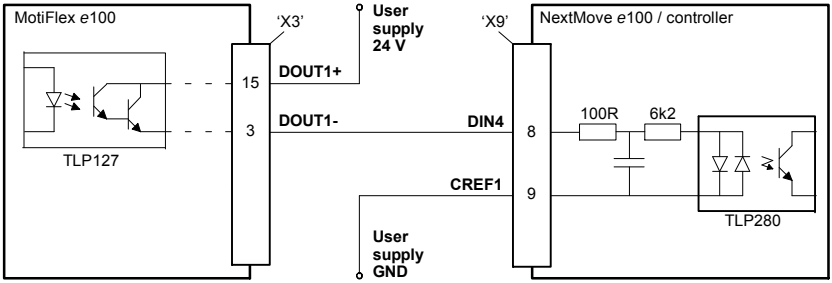
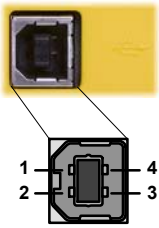


Figure 57 - DOUT1 - typical connections to a Baldor NextMove *e*100

5.4 USB interface

5.4.1 USB



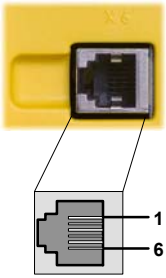
Location	USB Mating connector: USB Type B (downstream) plug	
Pin	**Name**	**Description**
1	-	(*NC*)
2	D-	Data-
3	D+	Data+
4	GND	Ground

The USB connector is used to connect the MotiFlex *e*100 to a PC running Mint WorkBench. The MotiFlex *e*100 is a self-powered, USB 1.1 (12 Mbit/s) compatible device. If it is connected to a slower USB1.0 host PC or hub, communication speed will be limited to the USB1.0 specification (1.5 Mbit/s). If it is connected to a faster USB2.0 (480 Mbit/s) host PC or hub, communication speed will remain at the USB1.1 specification of the MotiFlex *e*100.

Ideally, the MotiFlex *e*100 should be connected directly to a USB port on the host PC. If it is connected to a hub shared by other USB devices, communication could be affected by the activity of the other devices. A 2 m (6.5 ft) standard USB cable is supplied. The maximum recommended cable length is 5 m (16.4 ft).

5.5 RS485 interface

5.5.1 RS485 (2-wire)



Location	X6 Mating connector: RJ11 plug	
Pin	**Name**	**Description**
1	TXA	Transmit / receive +
2	TXB	Transmit / receive -
3	GND	Ground
4	+8 V out	8 V supply for Baldor accessories
5	*(NC)*	-
6	*(NC)*	-

The RS485 2-wire interface is used to connect third-party devices such as operator panels. The Baldor Keypad and Baldor HMI panel range cannot be connected to this interface, since they require a 4-wire RS485 connection. The 8 V supply on pin 4 is provided for future Baldor accessories; care should be taken to ensure this supply will not damage connected devices. The RS485 interface could be damaged if a USB plug is accidentally inserted while the drive is powered.

The Mint keyword `Print` can be used to send characters to the attached device. The Mint keyword `InKey` can be used to receive characters. The RS485 interface can also be used to exchange data using the Baldor Host Comms Protocol (HCP/HCP2). See the Mint WorkBench help file for details.

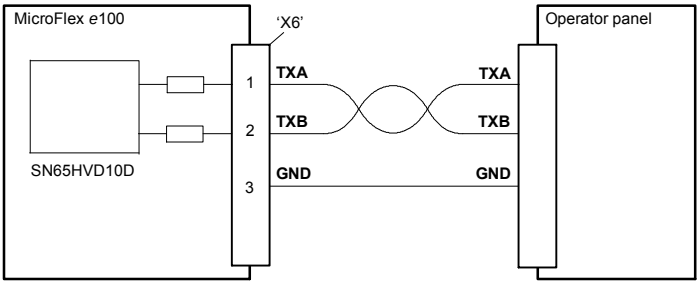


Figure 58 - RS485 port - typical connections to an RS485 2-wire operator panel

5.6 Ethernet interface

The Ethernet interface provides TCP/IP and Ethernet POWERLINK (EPL) networking capabilities.

5.6.1 TCP/IP

Transmission Control Protocol / Internet Protocol (TCP/IP) is a common set of protocols used to transfer information between devices over a network, including the internet. TCP enables two devices to establish a connection, and guarantees the delivery of packets (datagrams) of information in the correct order. IP specifies the format of the individual packets (which includes the destination address of the receiving device) but has no influence on whether the packet is delivered correctly.

TCP/IP allows the MotiFlex *e*100 to support standard Ethernet communication with a host PC running Mint WorkBench. The connection uses Baldor's high level ICM (Immediate Command Mode) protocol to allow Mint commands, Mint programs and even firmware to be sent to the controller over the Ethernet network.

When operating in standard Ethernet mode, TCP/IP cannot be used to communicate with a controller on a daisy-chained network. This is due to cumulative timing errors caused by each controller's internal hub. It is necessary to connect the host PC to the controller either directly or via a switch or hub, as shown in Figure 59. A switch is preferable to a hub as it will provide faster performance when there is a large amount of data being transmitted.

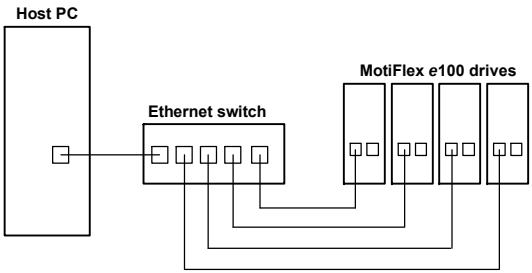


Figure 59 - Connecting to drives using TCP/IP in standard Ethernet mode

When operating in EPL mode, in conjunction with an EPL compatible router, the host PC *can* use TCP/IP to communicate with controllers on a daisy-chained network. In this situation, the router will use TCP/IP only within EPL's asynchronous time slots. See the Mint help file for further details.

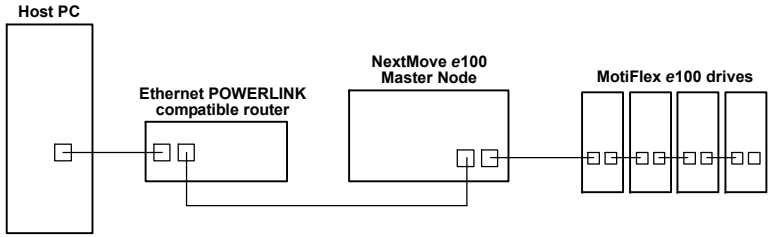


Figure 60 - Connecting to daisy-chained drives using TCP/IP and EPL mode

5.6.2 Ethernet POWERLINK

MotiFlex *e*100 supports the deterministic Ethernet POWERLINK (EPL) protocol. This protocol provides very precise and predictable 'real-time' communication over a 100 Mbit/s (100Base-T) Fast Ethernet (IEEE 802.3u) connection. This makes it suitable for the transmission of control and feedback signals between the MotiFlex *e*100 and other EPL enabled controllers such as NextMove *e*100. The EPL protocol implemented in Mint is based on the CANopen DS402 Device Profile for Drives and Motion Control.

MotiFlex *e*100 incorporates a built-in repeating hub, providing two ports for connection to other equipment. This allows nodes to be connected as a 'daisy-chain' network of up to 5 nodes, avoiding the need for additional hubs. If the network comprises more than 5 nodes an external hub must be used, with up to 5 nodes per port. The structure of the physical network is informal so does not need to reflect the logical relationship between nodes. Ethernet switches must not be used in EPL networks as their timing cannot be guaranteed.

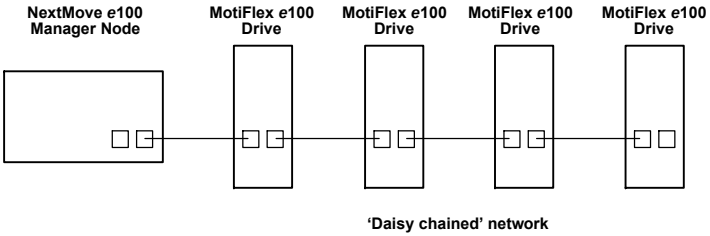


Figure 61 - Simple daisy-chained EPL network

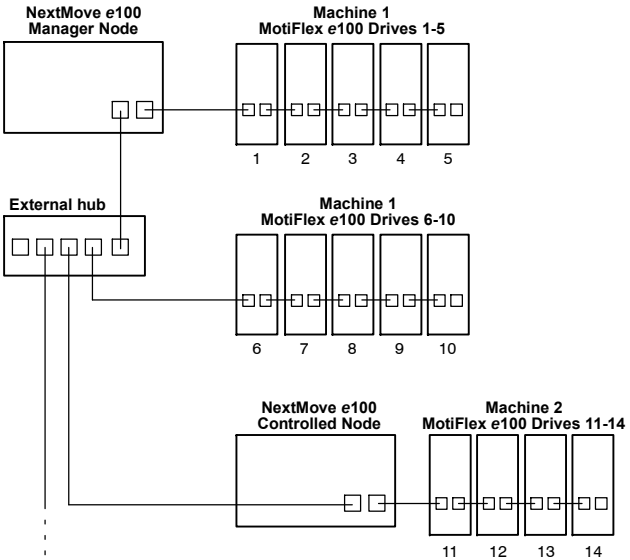


Figure 62 - Example multi-branch EPL network

5.6.3 Ethernet connectors

Ethernet connections are made using the identical RJ45 Ethernet receptacles.

Location	E1 & E2 (top panel)	
Pin	**Name**	**Description**
1	TX+	Transmit+
2	TX-	Transmit-
3	RX+	Receive+
4	-	*(NC)*
5	-	*(NC)*
6	RX-	Receive-
7	-	*(NC)*
8	-	*(NC)*

To connect the MotiFlex *e*100 to other EPL devices use CAT5e Ethernet cables - either S/UTP (screened unshielded twisted pairs) or preferably S/FTP (screened fully shielded twisted pairs).

The MotiFlex *e*100 Ethernet interface is galvanically isolated from the rest of the MotiFlex *e*100 circuitry by magnetic isolation modules incorporated in each of the Ethernet connectors. This provides protection up to 1.5 kV. The connector/cable screen is connected directly to the chassis earth of the MotiFlex *e*100. Termination components are incorporated in each of the Ethernet connectors, so no further termination is required. To ensure CE compliance, especially where Ethernet cables are frequently unplugged, all Ethernet cables should be bonded to the metal backplane using conductive clamps at one point at least (see section D.1.6). Cables longer than 3 m should be S/FTP cables bonded to the metal backplane at both ends. Do not run Ethernet cables close to AC supply cables, motor power cables, or other sources of noise as this can sometimes cause spurious errors to be reported.

Cables may be up to 100 m (328 ft) long. Two varieties of CAT5e cable are available; ‘straight’ or ‘crossed’. Straight cables have the TX pins of the connector at one end of the cable wired to the TX pins of the RJ45 connector at the other end of the cable. Crossover cables have the TX pins of the connector at one end of the cable wired to the RX pins of the RJ45 connector at the other end of the cable. Provided the network consists of only Baldor EPL controllers and drives (and any hub), straight or crossed cables may be used. This is because many Ethernet devices, including hubs and all Baldor EPL products, incorporate Auto-MDIX switching technology which automatically compensates for the wiring of the straight cable. However, if other manufacturers’ EPL nodes are included in the network, crossover cables should be used as recommended by the Ethernet POWERLINK Standardization Group (EPSG). Similarly, if a host PC does not provide Auto-MDIX on its Ethernet port, then a crossed cable will be essential for the connection between the PC and an EPL router, e.g. OPT036-501.

The EPL network supports the 100Base-TX (100 Mbit/s) system only, so attempting to connect slower 10Base-T (10 Mbit/s) nodes will cause a network error.

5.7 CAN interface

The CAN bus is a serial based network originally developed for automotive applications, but now used for a wide range of industrial applications. It offers low-cost serial communications with very high reliability in an industrial environment; the probability of an undetected error is 4.7×10^{-11}. It is optimized for the transmission of small data packets and therefore offers fast update of I/O devices (peripheral devices) connected to the bus.

The CAN protocol only defines the physical attributes of the network, i.e. the electrical, mechanical, functional and procedural parameters of the physical connection between devices. The higher level network functionality on MotiFlex *e*100 is defined by the CANopen protocol, one of the most used standards for machine control.

5.7.1 CAN connector

Location	CAN (top panel) Mating connector: 9-pin female D-type	
Pin	**Name**	**Description**
1	-	*(NC)*
2	CAN-	CAN channel negative
3	CAN GND	Ground/earth reference for CAN signals
4	-	*(NC)*
5	Shield	Shield connection
6	CAN GND	Ground/earth reference for CAN signals
7	CAN+	CAN channel positive
8	-	*(NC)*
9	CAN V+	CAN power V+ (12-24 VDC)

5.7.2 CAN wiring

A very low error bit rate over CAN can only be achieved with a suitable wiring scheme, so the following points should be observed:

- The two-wire data bus line may be routed parallel, twisted and/or shielded, depending on EMC requirements. Baldor recommend a twisted pair cable with the shield/screen connected to the connector backshell, in order to reduce RF emissions and provide immunity to conducted interference.
- The bus must be terminated at both ends only (not at intermediate points) with resistors of a nominal value of 120 Ω. This is to reduce reflections of the electrical signals on the bus, which helps a node to interpret the bus voltage levels correctly. If the MotiFlex *e*100 is at the end of the network then ensure that a 120 Ω resistor is fitted (normally inside the D-type connector).
- All cables and connectors should have a nominal impedance of 120 Ω. Cables should have a length related resistance of 70 mΩ/m and a nominal line delay of 5 ns/m.

- The maximum bus length depends on the bit-timing configuration (baud rate). The table opposite shows the approximate maximum bus length (worst-case), assuming 5ns/m propagation delay and a total effective device internal in-out delay of 210 ns at 1 Mbit/s, 300 ns at 500 - 250 Kbit/s, 450 ns at 125 Kbit/s and 1.5 ms at 50 - 10Kbit/s.

  (1) For bus lengths greater than about 1000 m, bridge or repeater devices may be needed.

CAN Baud Rate	Maximum Bus Length
1 Mbit/s	25 m
500 Kbit/s	100 m
250 Kbit/s	250 m
125 Kbit/s	500 m
100 Kbit/s	600 m
50 Kbit/s	1000 m
20 Kbit/s	2500 m(1)
10 Kbit/s	5000 m(1)

- The compromise between bus length and CAN baud rate must be determined for each application. The CAN baud rate can be set using the `BUSBAUD` keyword. It is essential that all nodes on the network are configured to run at the same baud rate.
- The wiring topology of a CAN network should be as close as possible to a single line/bus structure. However, stub lines are allowed provided they are kept to a minimum (<0.3 m at 1 Mbit/s).
- The 0 V connection of all of the nodes on the network must be tied together through the CAN cabling. This ensures that the CAN signal levels transmitted by MotiFlex *e*100 or CAN peripheral devices are within the common mode range of the receiver circuitry of other nodes on the network.

5.7.2.1 Opto-isolation

On the MotiFlex *e*100, the CAN channel is opto-isolated. A voltage in the range 12-24 VDC must be applied between pin 9 (+24 V) and pin 3 or 6 (0 V) of the CAN connector. From this supply, an internal voltage regulator provides the 5 V at 100 mA required for the isolated CAN circuit. To allow easy connection of the 12-24 VDC supply, Baldor adaptor part OPT-CNV002 can be used, allowing connection by ordinary CAT 5e Ethernet cables. The adaptor also provides flying lead connections for the application of the CAN power supply.

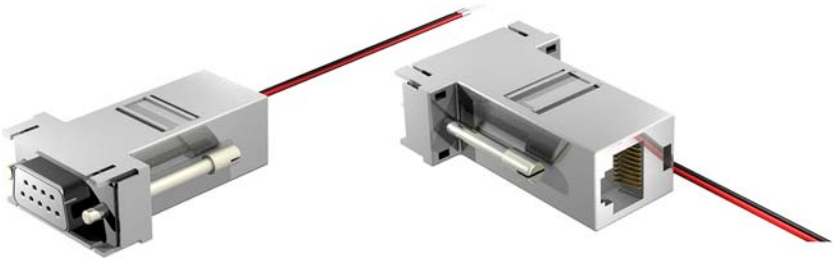


Figure 63 - OPT-CNV002

Alternatively, a connector such as the Phoenix Contact SUBCON-PLUS F3 (part 2761871) provides a 9-pin D-type female connector with easily accessible terminal block connections (see Figure 64).

CAN cables supplied by Baldor are ‘category 5’ and have a maximum current rating of 1 A, so the maximum number of MotiFlex *e*100 units that may be used on one network is limited to 10.

5.7.3 CANopen

Baldor have implemented a CANopen protocol in Mint (based on the 'Communication Profile' CiA DS-301) which supports both direct access to device parameters and time-critical process data communication. The MotiFlex *e*100 complies with CANopen slave device profile DS402, and can be a DS401 or DS403 master device (with limited functionality). It is able to support and communicate with a variety of devices including:

- Any third party digital and analog I/O device that is compliant with the 'Device Profile for Generic I/O Modules' (CiA DS-401).
- Baldor HMI (Human Machine Interface) operator panels, which are based on the 'Device Profile for Human Machine Interfaces' (DS403).
- Other Baldor controllers with CANopen support for peer-to-peer access using extensions to the CiA specifications (DS301 and DS302).

The functionality and characteristics of all Baldor CANopen devices are defined in individual standardized (ASCII format) Electronic Data Sheets (EDS) which can be found on the Baldor Motion Toolkit CD supplied with your product, or downloaded from www.baldormotion.com.
Figure 64 shows a typical CANopen network with a NextMove *e*100 manager node, one MotiFlex *e*100 slave node and a Baldor HMI operator panel:

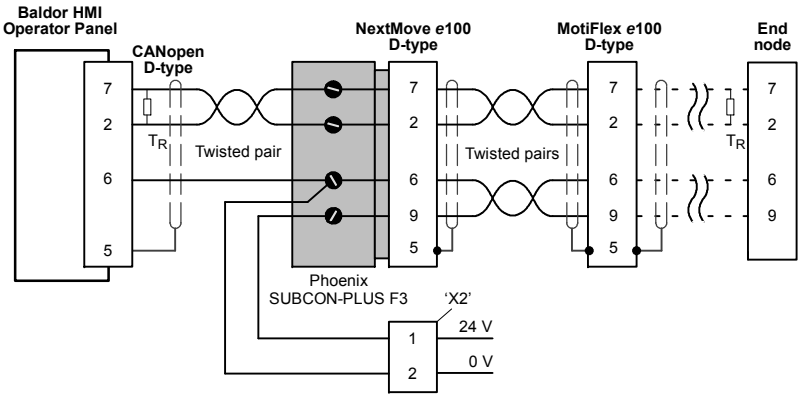


Figure 64 - Typical CANopen network connections

Note: The MotiFlex *e*100 CAN channel is opto-isolated, so a voltage in the range 12-24 VDC must be applied between pin 9 and pin 6 of the CAN connector. See section 5.7.2.1.

The configuration and management of a CANopen network must be carried out by a single node acting as the network manager (for example NextMove *e*100), or by a third party CANopen manager device. Up to 126 CANopen nodes (node IDs 2 to 127) can be added to the network by the manager node using the Mint `NODESCAN` keyword. If successful, the nodes can then be connected to using the Mint `CONNECT` keyword. Any network and node related events can then be monitored using the Mint `BUS1` event.

Note: All CAN related Mint keywords are referenced to CANopen using the *bus* parameter. For CANopen the *bus* parameter must be set to 1. Please refer to the Mint help file for further details on CANopen, Mint keywords and their parameters.

5.8 Other I/O

5.8.1 Node ID selector switches

The MotiFlex *e*100 has two selector switches which determine the unit's node ID on EPL networks. Each switch has 16 positions, allowing selection of the hexadecimal values 0 - F. In combination, the two switches allow node IDs of 0 - 255 (hexadecimal FF) to be selected. The switch labelled 'HI' sets the high nibble (half byte), and the switch labelled 'LO' sets the low nibble. The following table lists all node IDs from 0 to 255 with the equivalent HI and LO switch settings:

Node ID	HI	LO	Node ID	HI	LO	Node ID	HI	LO	Node ID	HI	LO
0	0	0	**64**	4	0	**128**	8	0	**192**	C	0
1	0	1	**65**	4	1	**129**	8	1	**193**	C	1
2	0	2	**66**	4	2	**130**	8	2	**194**	C	2
3	0	3	**67**	4	3	**131**	8	3	**195**	C	3
4	0	4	**68**	4	4	**132**	8	4	**196**	C	4
5	0	5	**69**	4	5	**133**	8	5	**197**	C	5
6	0	6	**70**	4	6	**134**	8	6	**198**	C	6
7	0	7	**71**	4	7	**135**	8	7	**199**	C	7
8	0	8	**72**	4	8	**136**	8	8	**200**	C	8
9	0	9	**73**	4	9	**137**	8	9	**201**	C	9
10	0	A	**74**	4	A	**138**	8	A	**202**	C	A
11	0	B	**75**	4	B	**139**	8	B	**203**	C	B
12	0	C	**76**	4	C	**140**	8	C	**204**	C	C
13	0	D	**77**	4	D	**141**	8	D	**205**	C	D
14	0	E	**78**	4	E	**142**	8	E	**206**	C	E
15	0	F	**79**	4	F	**143**	8	F	**207**	C	F
16	1	0	**80**	5	0	**144**	9	0	**208**	D	0
17	1	1	**81**	5	1	**145**	9	1	**209**	D	1
18	1	2	**82**	5	2	**146**	9	2	**210**	D	2
19	1	3	**83**	5	3	**147**	9	3	**211**	D	3
20	1	4	**84**	5	4	**148**	9	4	**212**	D	4
21	1	5	**85**	5	5	**149**	9	5	**213**	D	5
22	1	6	**86**	5	6	**150**	9	6	**214**	D	6
23	1	7	**87**	5	7	**151**	9	7	**215**	D	7
24	1	8	**88**	5	8	**152**	9	8	**216**	D	8
25	1	9	**89**	5	9	**153**	9	9	**217**	D	9
26	1	A	**90**	5	A	**154**	9	A	**218**	D	A
27	1	B	**91**	5	B	**155**	9	B	**219**	D	B
28	1	C	**92**	5	C	**156**	9	C	**220**	D	C
29	1	D	**93**	5	D	**157**	9	D	**221**	D	D

Node ID	HI	LO	Node ID	HI	LO	Node ID	HI	LO	Node ID	HI	LO
30	1	E	**94**	5	E	**158**	9	E	**222**	D	E
31	1	F	**95**	5	F	**159**	9	F	**223**	D	F
32	2	0	**96**	6	0	**160**	A	0	**224**	E	0
33	2	1	**97**	6	1	**161**	A	1	**225**	E	1
34	2	2	**98**	6	2	**162**	A	2	**226**	E	2
35	2	3	**99**	6	3	**163**	A	3	**227**	E	3
36	2	4	**100**	6	4	**164**	A	4	**228**	E	4
37	2	5	**101**	6	5	**165**	A	5	**229**	E	5
38	2	6	**102**	6	6	**166**	A	6	**230**	E	6
39	2	7	**103**	6	7	**167**	A	7	**231**	E	7
40	2	8	**104**	6	8	**168**	A	8	**232**	E	8
41	2	9	**105**	6	9	**169**	A	9	**233**	E	9
42	2	A	**106**	6	A	**170**	A	A	**234**	E	A
43	2	B	**107**	6	B	**171**	A	B	**235**	E	B
44	2	C	**108**	6	C	**172**	A	C	**236**	E	C
45	2	D	**109**	6	D	**173**	A	D	**237**	E	D
46	2	E	**110**	6	E	**174**	A	E	**238**	E	E
47	2	F	**111**	6	F	**175**	A	F	**239**	E	F
48	3	0	**112**	7	0	**176**	B	0	**240**	F	0
49	3	1	**113**	7	1	**177**	B	1	**241**	F	1
50	3	2	**114**	7	2	**178**	B	2	**242**	F	2
51	3	3	**115**	7	3	**179**	B	3	**243**	F	3
52	3	4	**116**	7	4	**180**	B	4	**244**	F	4
53	3	5	**117**	7	5	**181**	B	5	**245**	F	5
54	3	6	**118**	7	6	**182**	B	6	**246**	F	6
55	3	7	**119**	7	7	**183**	B	7	**247**	F	7
56	3	8	**120**	7	8	**184**	B	8	**248**	F	8
57	3	9	**121**	7	9	**185**	B	9	**249**	F	9
58	3	A	**122**	7	A	**186**	B	A	**250**	F	A
59	3	B	**123**	7	B	**187**	B	B	**251**	F	B
60	3	C	**124**	7	C	**188**	B	C	**252**	F	C
61	3	D	**125**	7	D	**189**	B	D	**253**	F	D
62	3	E	**126**	7	E	**190**	B	E	**254**	F	E
63	3	F	**127**	7	F	**191**	B	F	**255**	F	F

Figure 65 - Decimal node IDs and equivalent HI / LO hexadecimal switch settings

Note: If the node ID selector switches are set to FF, the node's firmware will not run on power up. However, Mint WorkBench will still be able to detect the MotiFlex *e*100 and download new firmware.

In many networking environments, the node ID may also be referred to as the *address*. On EPL networks, limitations apply to the node IDs that may be selected:

- Node ID 0 is reserved for special purposes and cannot be used.
- Setting the switches to select a node ID between 1 and 239 causes the node to become a 'controlled node', a node that will accept commands from the manager node.
- Node ID 240 is reserved for the EPL manager node (for example NextMove *e*100) so cannot be used by MotiFlex *e*100.
- Node IDs between 241 and 255 are reserved for special purposes and cannot be used.

For all other communication channels such as CANopen and USB, the node ID is set in software. Each channel can have a different node ID, selected using the Mint WorkBench Connectivity Wizard or the Mint `BUSNODE` keyword. See the Mint help file for details.

6.1 Introduction

Before powering the MotiFlex *e*100 you will need to connect it to the PC using a USB or Ethernet cable and install the supplied *Mint Machine Center* software. This software includes a number of tools to allow you to configure and tune the MotiFlex *e*100. If you do not have experience of software installation or Windows applications you may need further assistance for this stage of the installation.

6.1.1 Connecting the MotiFlex *e*100 to the PC

The MotiFlex *e*100 can be connected to the PC using either USB (recommended) or TCP/IP.

To use USB, connect a USB cable between a PC USB port and the MotiFlex *e*100 USB port. The PC must be running Windows XP, Windows Vista or Windows 7.

To use TCP/IP, connect a CAT5e Ethernet cable between the PC and one of the MotiFlex *e*100 Ethernet ports.

You cannot connect an ordinary office PC to the MotiFlex *e*100 without first altering the PC's Ethernet adapter configuration. However, if you have installed a second Ethernet adapter dedicated for use with the MotiFlex *e*100, then this adapter's configuration can be altered without affecting the PC's office Ethernet connection. If you are unsure about making changes to your PC's Ethernet adapter configuration, or are prevented by user permission levels, ask your I.T. administrator to assist you.

If there is an EPL manager node (node ID 240) on the Ethernet network, then the network will be operating in EPL mode. This means any TCP/IP connection from the PC must pass through an EPL compatible router, e.g. Baldor part OPT036-501.

6.1.2 Installing Mint Machine Center and Mint WorkBench

You will need to install Mint Machine Center (MMC) and Mint WorkBench to configure and tune the MotiFlex *e*100. Any previous version of Mint WorkBench must be uninstalled before proceeding with this installation:

1. Insert the CD into the drive.
2. After a few seconds the setup wizard should start automatically. If the setup wizard does not appear, select Run... from the Windows Start menu and type

   d:\start

   where **d** represents the drive letter of the CD device.

   Follow the on-screen instructions to install MMC (including Mint WorkBench). The setup wizard will copy the files to appropriate folders within the C:\Program Files folder, and place shortcuts on the Windows Start menu.

6.2 Starting the MotiFlex *e*100

If you have followed the instructions in the previous sections, you should now have connected all the power sources, inputs and outputs, and the Ethernet cable or USB cable linking the PC to the MotiFlex *e*100.

6.2.1 Preliminary checks

Before you apply power for the first time, it is very important to verify the following:

- Disconnect the load from the motor until instructed to apply a load. If this cannot be done, disconnect the motor wires at connector X1.
- Verify that the AC line voltage (if connected) matches the specification of the MotiFlex *e*100.

  Note: If the MotiFlex *e*100 is to be powered from a shared DC bus connection, ensure that the busbars are securely fitted to the DC busbar pads under the top cover.
- Inspect all power connections for accuracy, workmanship and tightness.
- Verify that all wiring conforms to applicable codes.
- Verify that the MotiFlex *e*100 and motor are properly earthed/grounded.
- Check all signal wiring for accuracy.

6.2.2 Power on checks

If at any time the Status LED flashes red, the drive has detected a fault - see section 7.

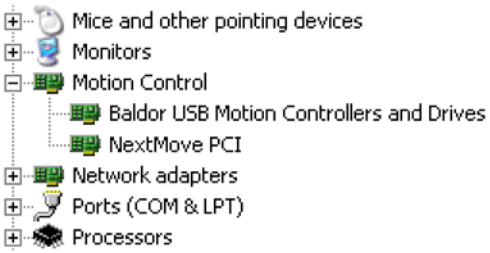
1. Turn on the AC supply.

   Note: If the MotiFlex *e*100 is to be powered from a shared DC bus connection, the preliminary checks shown in section 6.2.1 must first be completed for the MotiFlex *e*100 that will be supplying the DC bus voltage (the source drive). When these checks have been completed AC power can be applied to the source drive.
2. Turn on the optional 24 VDC control circuit backup supply, if connected.
3. Within approximately 20-30 seconds, the test sequence should complete and the Status LED should illuminate red. If the Status LED is not lit then re-check the power supply connections. If the Status LED flashes red, this indicates that the MotiFlex *e*100 has detected a fault - see section 7. Note that after downloading firmware, startup may take more than 1 minute.
4. If the motor wires were disconnected in section 6.2.1, turn off the AC supply and reconnect the motor wires. Turn on the AC supply.
5. To allow the Commissioning Wizard to function, the drive enable signal will need to be present on connector X3 to allow the MotiFlex *e*100 to be enabled (see section 5.3.1.). If you do not wish to enable the MotiFlex *e*100 yet, the Commissioning Wizard will inform you when this step is necessary.

6.2.3 Installing the USB driver

It is now necessary to install the USB driver. When the MotiFlex *e*100 is powered, Windows will automatically detect the controller and request the driver.

1. Follow the on-screen instructions to select and install the driver. The driver files are available on the supplied Baldor Motion Toolkit CD. If you are using a copy of the driver located on the hard disk, USB stick, or another CD, the driver files must all be in the same folder.
2. During installation, Windows may report that the driver is 'unsigned'. This is normal for the MotiFlex *e*100 driver, so click the Continue Anyway button to continue with the installation. When installation is complete, a new Motion Control category will be listed in Windows Device Manager.



The MotiFlex *e*100 is now ready to be configured using Mint WorkBench.

Note: If the MotiFlex *e*100 is later connected to a different USB port on the host computer, Windows may report that it has found new hardware. Either install the driver files again for the new USB port, or connect the MotiFlex *e*100 to the original USB port where it will be recognized in the usual way.

6.2.4 Configuring the TCP/IP connection (optional)

If you have connected the MotiFlex *e*100 to the PC using the Ethernet connection, it will be necessary to alter the PC's Ethernet adapter configuration to operate correctly with the MotiFlex *e*100.

You cannot connect an ordinary office PC to the MotiFlex *e*100 without first altering the PC's Ethernet adapter configuration. However, if you have installed a second Ethernet adapter dedicated for use with the MotiFlex *e*100, then this adapter's configuration can be altered without affecting the PC's office Ethernet connection. If you are unsure about making changes to your PC's Ethernet adapter configuration, or are prevented by user permission levels, ask your I.T. administrator to assist you.

The following explanation assumes the PC is connected directly to the MotiFlex *e*100, and not across an intermediate Ethernet network. If you wish to attempt the connection through an intermediate Ethernet network, then the network administrator must be consulted to ensure that the necessary IP addresses will be allowed and are not already allocated on the network. The MotiFlex *e*100 has a fixed IP address of the format 192.168.100.*xxx*. The last number, *xxx*, is the decimal value defined by the MotiFlex *e*100's node ID selector switches (see section 5.8.1).

1. On the Windows Start menu, select Settings, Network Connections.
2. In the Network Connections Window, right-click the 'Local Area Connection' entry for the required Ethernet adapter and choose Properties.
3. In the Local Area Connection Properties dialog, in the 'This connection uses the following items' list, select the 'Internet Protocol (TCP/IP)' entry and click **Properties**.
4. In the Internet Protocol (TCP/IP) Properties dialog, on the General tab, make a note of the existing settings. Click **Advanced...** and make a note of any existing settings. Click the Alternate Configuration tab and make a note of any existing settings.
5. On the General tab, choose the 'Use the following IP address' option.
6. In the IP address box, enter the IP address 192.168.100.241. This is the IP address that will be assigned to the Ethernet adapter. The value 241 is deliberately chosen as it is outside the range that can be used by MotiFlex *e*100, so avoiding any chance of conflicts.
7. In the Subnet mask box, enter 255.255.255.0 and click **OK**.
   Click **OK** to close the Local Area Connection Properties dialog.
8. On the Windows Start menu, select Command Prompt (often found under Accessories).
9. In the Command Prompt window, type PING 192.168.100.16, where the final value (16 in this example) is the value selected by the MotiFlex *e*100's node ID selector switches. In this example, the MotiFlex *e*100's switches would be set to HI=1 LO=0, which represents hexadecimal 10, equivalent to decimal 16 (see section 5.8.1 for a list of hexadecimal / decimal equivalents). A reply message should be returned.
10. It should now be possible to run Mint WorkBench and connect to the MotiFlex *e*100 using the Ethernet / TCP/IP connection.

6.3 Mint Machine Center

The Mint Machine Center (MMC) is used to view the network of connected controllers in a system. Individual controllers and drives are configured using Mint WorkBench.

Note: If you have only a single MotiFlex *e*100 connected to your PC, then MMC is probably not required. Use Mint WorkBench (see section 6.4) to configure the MotiFlex *e*100.

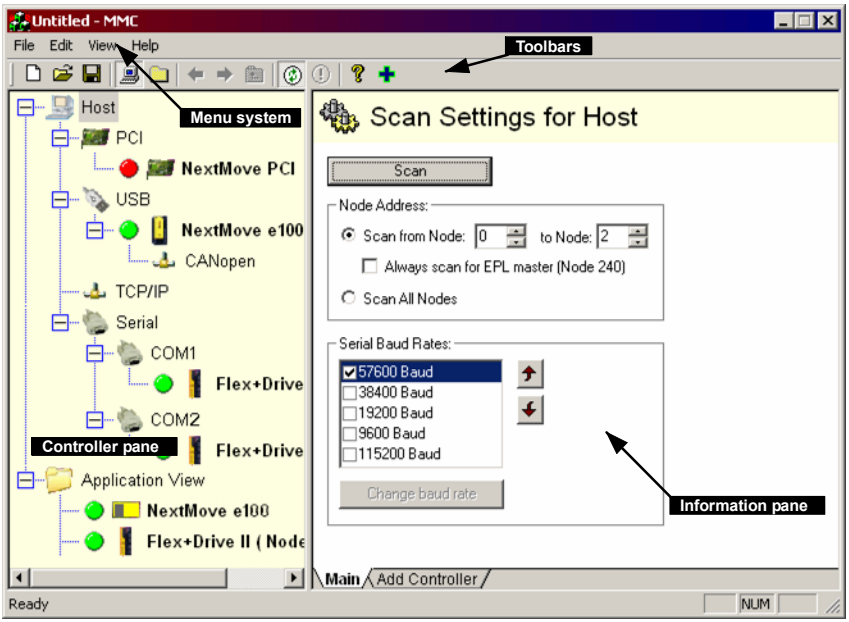


Figure 66 - The Mint Machine Center software

The Mint Machine Center (MMC) provides an overview of the controller network currently accessible by the PC. The MMC contains a controller pane on the left, and an information pane on the right. In the controller pane select the Host item, then in the information pane click **Scan**. This causes MMC to scan for all connected controllers. Clicking once on a controller's name causes various options to be displayed in the information pane. Double-clicking on a controller's name launches an instance of Mint WorkBench that is automatically connected to the controller.

Application View allows the layout and organization of controllers in your machine to be modeled and described on screen. Controllers can be dragged onto the Application View icon, and renamed to give a more meaningful description, for example "Conveyor 1, Packaging Controller". Drives that are controlled by another product, such as a NextMove *e*100, can be dragged onto the NextMove *e*100 icon itself, creating a visible representation of the machine. A text description for the system and associated files can be added, and the resulting layout saved as an "MMC Workspace". When you next need to administer the system, simply loading the workspace automatically connects to all the required controllers. See the Mint help file for full details of MMC.

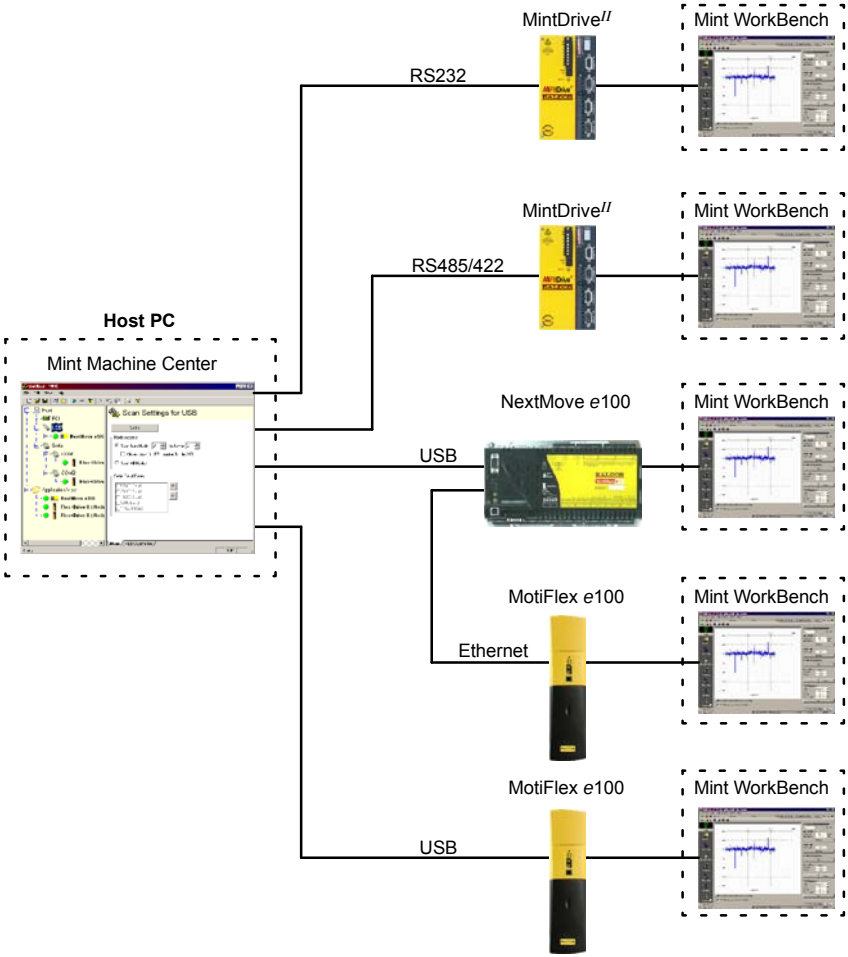
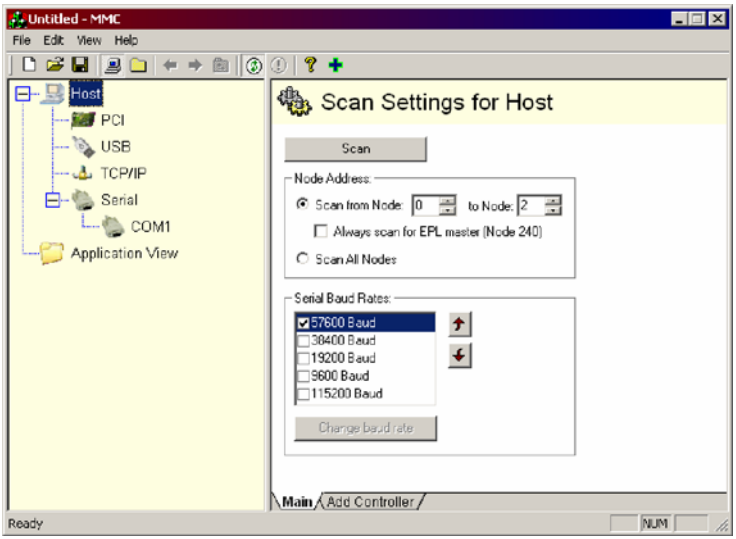


Figure 67 - Typical network visibility provided by Mint Machine Center

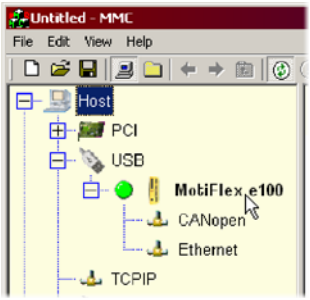
6.3.1 Starting MMC

1. On the Windows **Start** menu, select Programs, Mint Machine Center, Mint Machine Center.



2. In the controller pane, ensure that Host is selected. In the information pane, click **Scan.**

3. When the search is complete, click once on 'MotiFlex e100' in the controller pane to select it, then double click to open an instance of Mint WorkBench. The MotiFlex e100 will be already connected to the instance of Mint WorkBench, ready to configure.



6.4 Mint WorkBench

Mint WorkBench is a fully featured application for commissioning and programming the MotiFlex *e*100. The main Mint WorkBench window contains a menu system, the Toolbox and other toolbars. Many functions can be accessed from the menu or by clicking a button - use whichever you prefer. Most buttons include a 'tool-tip'; hold the mouse pointer over the button (don't click) and its description will appear.

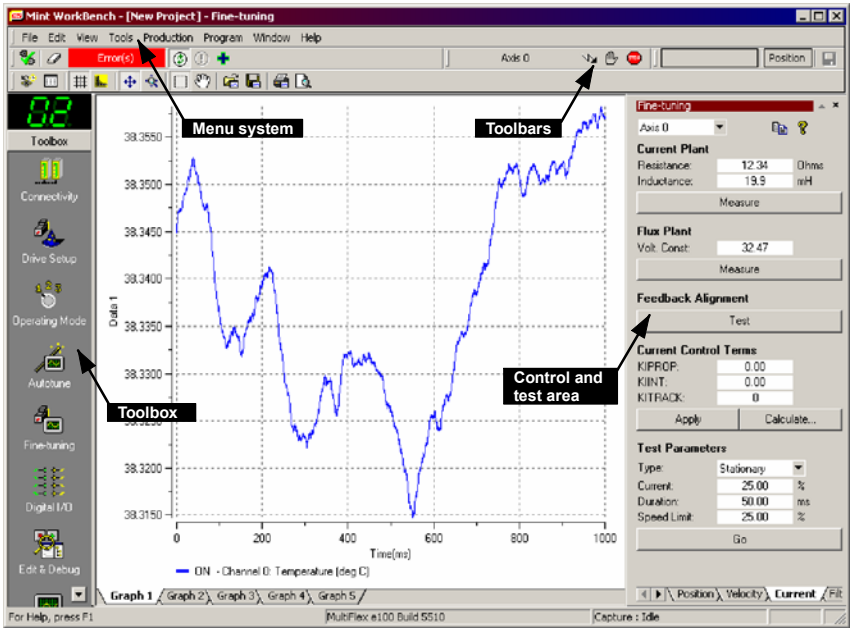


Figure 68 - The Mint WorkBench software

6.4.1 Help file

Mint WorkBench includes a comprehensive help file that contains information about every Mint keyword, how to use Mint WorkBench and background information on motion control topics. The help file can be displayed at any time by pressing F1. On the left of the help window, the Contents tab shows the tree structure of the help file. Each book contains a number of topics. The Index tab provides an alphabetic list of all topics in the file, and allows you to search for them by name. The Search tab allows you to search for words or phrases appearing anywhere in the help file. Many words and phrases are underlined and highlighted with a color (normally blue) to show that they are links. Just click on the link to go to an associated keyword. Most keyword topics begin with a list of relevant *See Also* links.

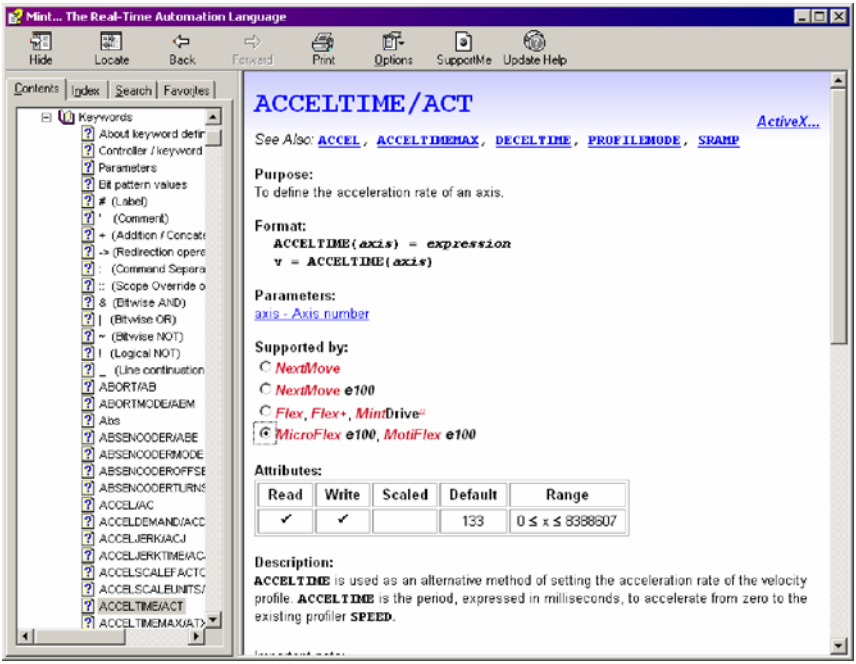


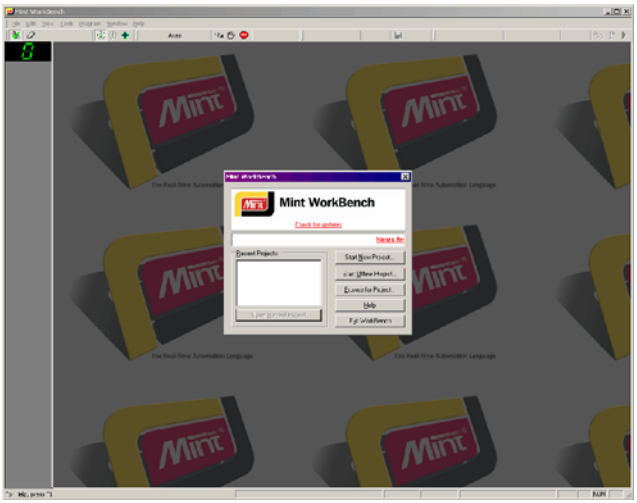
Figure 69 - The Mint WorkBench help file

For help on using Mint WorkBench, click the **Contents** tab, then click the small plus sign beside the **Mint WorkBench** book icon. Double click a topic name to display it.

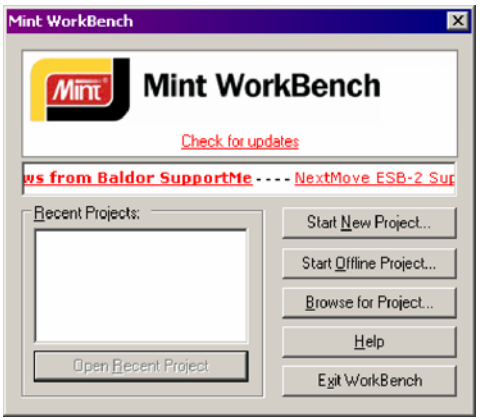
6.4.2 Starting Mint WorkBench

Note: If you have already used MMC to start an instance of Mint WorkBench then the following steps are unnecessary. Go to section 6.4.3 to continue configuration.

1. On the Windows **Start** menu, select Programs, Mint Machine Center, WorkBench v5.5.

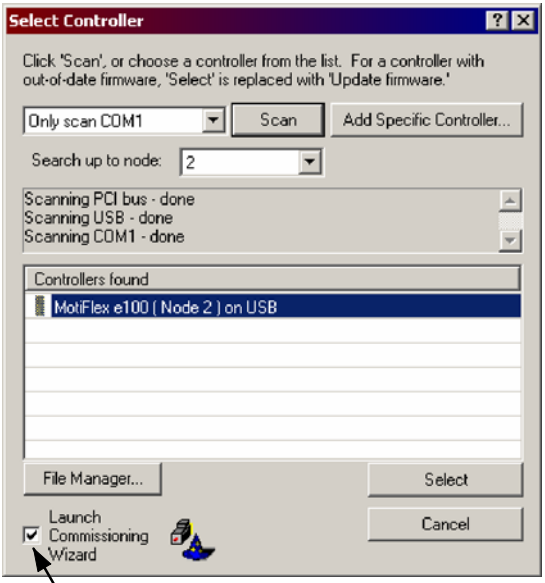


2. In the opening dialog box, click **Start New Project...** .



3. In the Select Controller dialog, click **Scan** to search for the MotiFlex *e*100. Mint WorkBench will scan the PC's ports for the MotiFlex *e*100.

   When the search is complete, click 'MotiFlex e100' in the list to select it, then click **Select**.

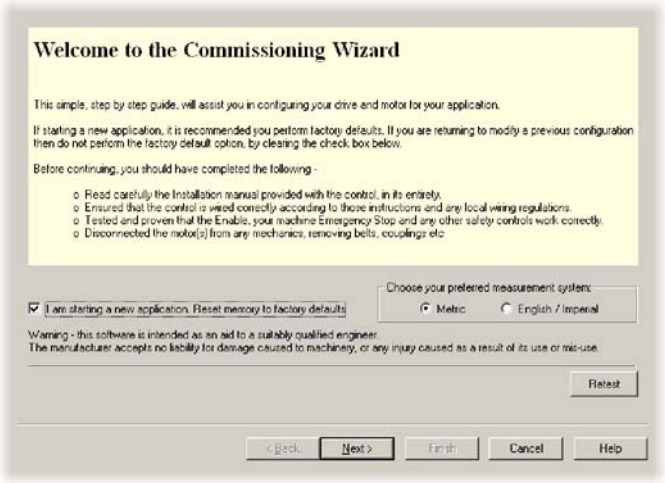

Select Controller
Click 'Scan', or choose a controller from the list. For a controller with out-of-date firmware, 'Select' is replaced with 'Update firmware.'
Only scan COM1
Scan
Add Specific Controller...
Search up to node:
2
Scanning PCI bus - done
Scanning USB - done
Scanning COM1 - done
Controllers found
MotiFlex e100 (Node 2) on USB
File Manager...
Select
Cancel
Launch Commissioning Wizard
This check box is already selected for you. When you click **Select**, it means that the Commissioning Wizard will start automatically.

Note: If the MotiFlex *e*100 is not listed, check the USB or Ethernet cable between the MotiFlex *e*100 and the PC. Check that the MotiFlex *e*100 is powered correctly. Click **Scan** to re-scan the ports.

6.4.3 Commissioning Wizard

Each type of motor and drive combination has different performance characteristics. Before the MotiFlex *e*100 can be used to control the motor accurately, the MotiFlex *e*100 must be 'tuned'. This is the process where the MotiFlex *e*100 powers the motor in a series of tests. By monitoring the drive's output and the feedback from the motor's encoder, the MotiFlex *e*100 can make small adjustments to the way it controls the motor. This information is stored in the MotiFlex *e*100 and can be uploaded to a file if necessary.

The Commissioning Wizard provides a simple way to tune the MotiFlex *e*100 and create the necessary configuration information for your drive/motor combination, so this is the first tool that should be used. If necessary, any of the parameters set by the Commissioning Wizard can be adjusted manually after commissioning is complete.


Welcome to the Commissioning Wizard
This simple, step by step guide, will assist you in configuring your drive and motor for your application.
If starting a new application, it is recommended you perform factory defaults. If you are returning to modify a previous configuration then do not perform the factory default option, by clearing the check box below.
Before continuing, you should have completed the following -
o Read carefully the Installation manual provided with the control, in its entirety.
o Ensured that the control is wired correctly according to those instructions and any local wiring regulations.
o Tested and proven that the Enable, your machine Emergency Stop and any other safety controls work correctly.
o Disconnected the motor(s) from any mechanics, removing belts, couplings etc
I am starting a new application. Reset memory to factory defaults
Choose your preferred measurement system:
Metric
English / Imperial
Warning - this software is intended as an aid to a suitably qualified engineer.
The manufacturer accepts no liability for damage caused to machinery, or any injury caused as a result of its use or mis-use.
Retest
< Back
Next >
Finish
Cancel
Help

6.4.4 Using the Commissioning Wizard

Each screen of the Commissioning Wizard requires you to enter information about the motor, drive or application. Read each screen carefully and enter the required information. When you have completed a screen, click **Next >** to display the next screen. If you need to change something on a previous screen, click the **< Back** button. The Commissioning Wizard remembers information that you have entered so you will not need to re-enter everything if you go back to previous screens. If you need extra help, click **Help** or press F1.

6.4.4.1 Connectivity

If you wish to change a node ID or baud rate then click in the appropriate cell and select an alternative value. When multiple controllers are to be connected on the same bus they must each have a unique node ID. For example, if two MotiFlex *e*100s and a NextMove *e*100 are connected to the PC using individual USB connections, they must each be assigned a unique USB node ID.

6.4.4.2 DC bus sharing

Refer to section 3.5, and in particular section 3.5.2, for important details about DC bus sharing.

If the drive is being used as a 'standalone' drive (it is not sharing its DC bus or deriving power from another drive's DC bus) it is not necessary to change anything on this screen. However, if the drive is sharing its DC bus (it is a 'source' drive), or deriving its power from another drive's DC bus (it is a 'receiving' drive), this stage must be completed.

- For a source drive: Select the *DC bus master* option, then select the chosen 'power ready' digital output.
- For a receiving drive: Select the *DC bus slave* option, then select the chosen 'power ready' digital input.

6.4.4.3 Select your Motor Type:

Select the type of motor that you are using (rotary or linear).

6.4.4.4 Select your Motor:

Carefully enter the details of your motor. If you are using a Baldor Motor, the catalog number or spec. number can be found stamped on the motor's nameplate. If you are using a motor with EnDat feedback, are not using a Baldor motor, or need to enter the specification manually, select the *I would like to define a custom motor option*.

6.4.4.5 Confirm Motor and Drive information:

If you entered the catalog or spec. number on the previous page, it is not necessary to change anything on this screen; all the required data will be entered already. However, if you selected the *I would like to define a custom motor option*, it will be necessary to enter the required information before continuing.

6.4.4.6 Motor Feedback:

If you entered the catalog or spec. number on the previous page, it is not necessary to change anything on this screen; the feedback resolution will be entered already. However, if you selected the *I would like to define a custom motor option*, it will be necessary to enter the feedback resolution before continuing.

6.4.4.7 Drive Setup complete:

This screen confirms that drive setup is complete.

6.4.4.8 Select Operating Mode and Control Reference Source:

In the Operating Mode section, choose the required operating mode. In the Reference Source section, choose the reference source that will be used to control the drive in its intended application. For example, if the MotiFlex *e*100 will be eventually controlled over Ethernet POWERLINK (EPL), the EPL reference source should be selected. If EPL or CAN is selected, Mint WorkBench will ask for the reference source to be changed to Host/Mint during the remainder of the commissioning process. This allows it to complete autotuning tests and enables further initial testing to be performed. When the drive is next power cycled, the setting chosen in the Select Operating Mode tool is always reinstated. In Mint WorkBench, the reference source can be temporarily changed by using the Control Ref Source button on the motion toolbar, which also displays the current operating mode.

6.4.4.9 Application Limits:

It may not be necessary to change anything on this screen. However, if you wish to adjust the application peak current (*App. Peak Current*) and/or application maximum speed (*App. Max. Speed*), then click in the appropriate box and enter a value.

6.4.4.10 Select Scale Factor:

It is not necessary to change anything on this screen. However, it is recommended to select a user unit for position, velocity and acceleration. This allows Mint WorkBench to display distances, speeds and accelerations using meaningful units, instead of encoder counts. For example, selecting a *Position User Unit* of Revs (r) will mean that all position values entered or displayed in Mint WorkBench will represent revolutions. The *Position Scale Factor* value will change automatically to represent the required scale factor (the number of quadrature counts per revolution). If you need to use an alternative unit, for example degrees, type “Degrees” in the *Position User Unit* box and enter a suitable value in the *Position Scale Factor* box. Separate velocity and acceleration units can also be defined. See the Mint help file for more information about scale factors.

6.4.4.11 Profile Parameters:

Click in the appropriate boxes and enter values for the default profile parameters. A brief description of each item is given at the bottom of the window. For further help, click the Help button.

6.4.4.12 Analog Input Parameters

This screen allows the analog input to be configured. This step is required only if the analog input is to be used as a command reference source (previously selected in the Operating Mode screen), or as a general purpose analog input.

6.4.4.13 Operation setup complete:

This screen confirms that operation setup is complete. All changed parameters have been saved on the MotiFlex *e*100.

6.4.5 Autotune Wizard

The Autotune Wizard tunes the MotiFlex *e*100 for optimal performance with the attached motor. This removes the need for manual fine-tuning of the system, although in some critical applications this still may be required.

Click **Options...** to configure optional autotuning parameters. These include Triggered Autotune which allows the autotuning process to be delayed until the drive is enabled.

CAUTION

The motor will move during autotuning. For safety it is advisable to disconnect any load from the motor during initial autotuning. The motor can be tuned with the load connected after the Commissioning Wizard has finished.

Autotune:
Click **START** to begin the auto-tuning process. Mint WorkBench will take measurements from the motor and then perform small test moves.

For further information about tuning with the load attached, see section 6.4.7.

6.4.6 Further tuning - no load attached

The Autotune Wizard calculates many parameters that allow the MotiFlex *e*100 to provide good control of the motor. In some applications, these parameters may need to be fine-tuned to provide the exact response that you require.

1. Click the Fine-tuning icon in the Toolbox on the left of the screen.

   The Fine-tuning window is displayed at the right of the screen. This already shows some of the parameters that have been calculated by the Commissioning Wizard.

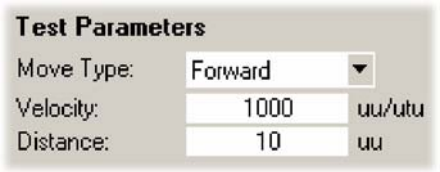
   The main area of the Mint WorkBench window displays the capture window. When further tuning tests are performed, this will display a graph representing the response.

2. The Fine-tuning window has a number of tabs at the bottom.

   Click on the Velocity tab.

   Note: Some tabs may not be available depending on the configuration mode you selected in the Commissioning Wizard.

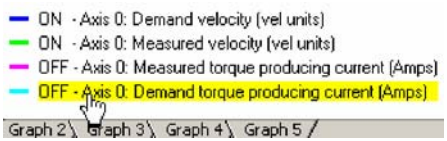
3. In the Test Parameters area at the bottom of the tab, click in the Move Type drop down box and select Forward.



   In the Velocity and Distance boxes, enter values to create a short move. The values you enter depend on the velocity scaling factor that was selected in the Commissioning Wizard. This example assumes the velocity scaling factor was selected as Revs Per Minute (rpm), so entering a value of 1000 here will create a move with a velocity of 1000 rpm. Similarly, assuming the position scaling factor had been set to Revolutions (r), the value 10 will create a move lasting for 10 revolutions of the motor.

4. Click **Go** to start the test move. Mint WorkBench will perform the test move and display a graph of the result.

5. Click on the graph labels to turn off unwanted traces. Leave just Demand Velocity and Measured Velocity turned on.


ON - Axis 0: Demand velocity (vel units)
ON - Axis 0: Measured velocity (vel units)
OFF - Axis 0: Measured torque producing current (Amps)
OFF - Axis 0: Demand torque producing current (Amps)
Graph 2
Graph 3
Graph 4
Graph 5

   Note: The graph that you see will not look exactly the same as the following graph! Remember that each motor has a different response.

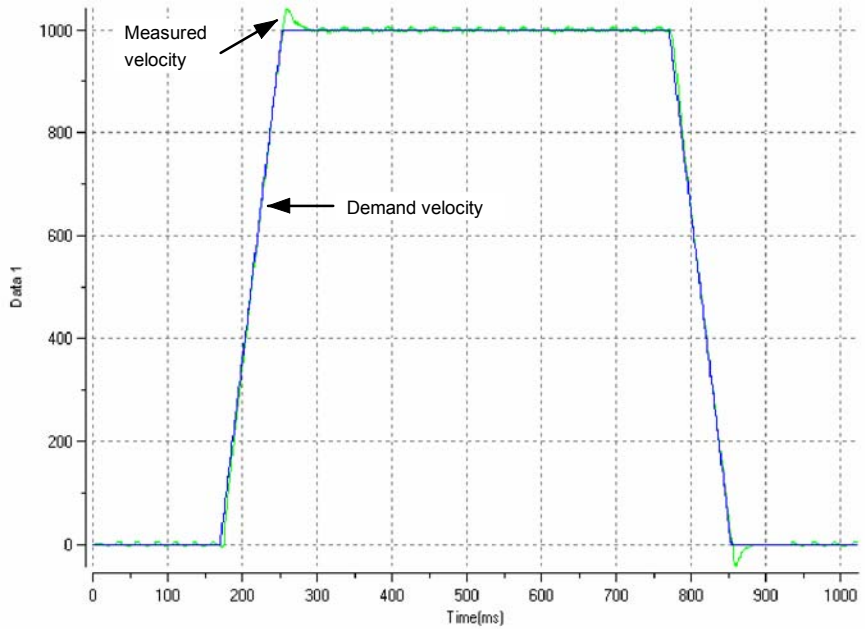


Figure 70 - Typical autotuned response (no load)

Figure 70 shows that the response reaches the demand quickly and only overshoots the demand by a small amount. This can be considered an ideal response for most systems.

For further information about tuning with the load attached, see section 6.4.7.

6.4.7 Further tuning - with load attached

To allow Mint WorkBench to adjust the basic tuning to compensate for the intended load, it is necessary to attach the load to the motor and then perform the autotune procedure again.

1. Attach the load to the motor.

2. Click the Autotune icon in the Toolbox on the left of the screen.

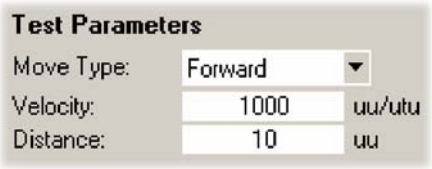
3. Click the Autotune on load check box.

4. Click **START** to begin the auto-tuning process. Mint WorkBench will take measurements from the motor and then perform small test moves.

5. Click the Fine-tuning icon in the Toolbox on the left of the screen.

6. In the Velocity tab's Test Parameters area, ensure the same move parameters are entered and then click **Go** to start the test move.

   Mint WorkBench will perform the test move and display a graph of the result.



6.4.8 Optimizing the velocity response

It may be desirable to optimize the default autotuned response to better suit your application. The following sections describe the two main tuning issues and how to correct them.

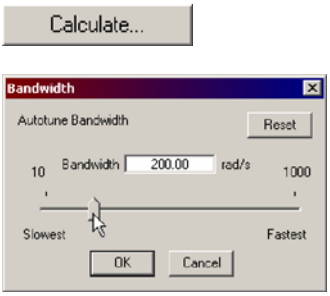
6.4.8.1 Correcting overshoot

Figure 71 shows a response where the measured velocity overshoots the demand by a significant amount.

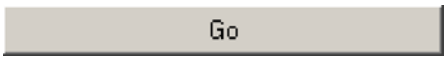
1. Go to the Fine-tuning window's Velocity tab.

   To reduce the amount of overshoot, click **Calculate...** and increase the bandwidth using the slider control. Alternatively, type a larger value in the Bandwidth box.

   Click **OK** to close the Bandwidth dialog.



2. Click **Go** to start the test move. Mint WorkBench will perform the test move and display a graph of the result.



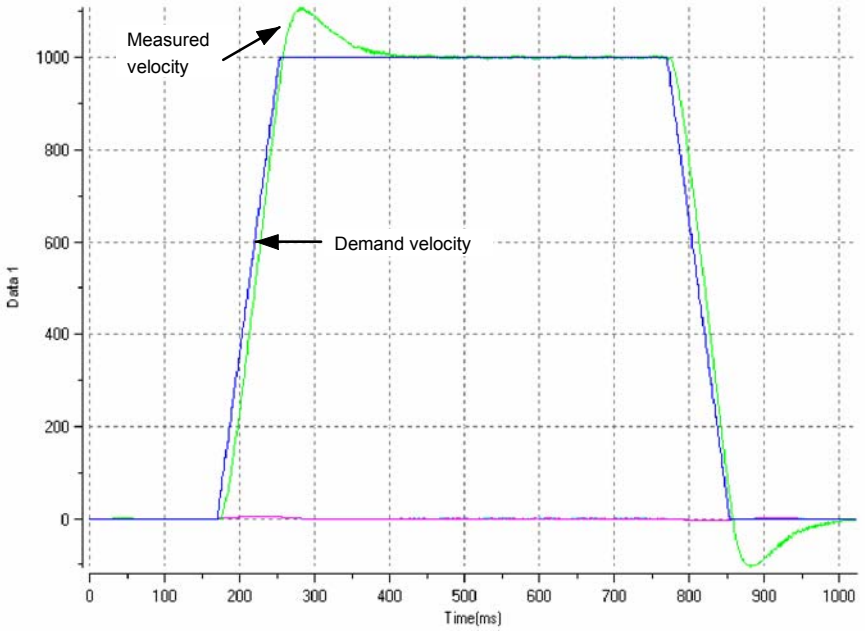


Figure 71 - Velocity overshoots demand

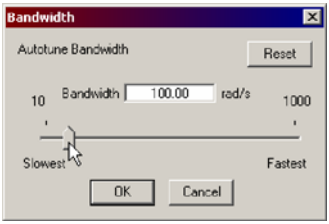
6.4.8.2 Correcting zero-speed noise in the velocity response

Figure 72 shows a response where there is very little overshoot but a significant amount of zero-speed noise. This can cause undesirable humming or ringing in the motor.

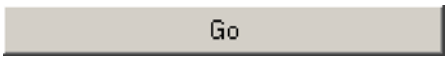
1. Go to the Fine-tuning window's Velocity tab.

   To reduce the amount of noise, click **Calculate...** and decrease the bandwidth using the slider control. Alternatively, type a smaller value in the Bandwidth box.

   Click **OK** to close the Bandwidth dialog.



2. Click **Go** to start the test move. Mint WorkBench will perform the test move and display a graph of the result.



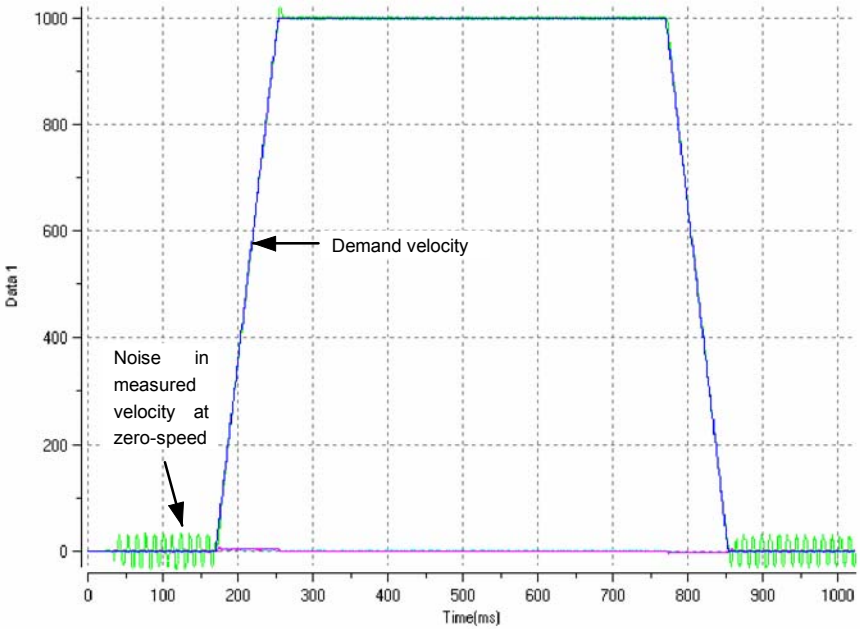


Figure 72 - Zero-speed noise

6.4.8.3 Ideal velocity response

Repeat the tests described in sections 6.4.8.1 and 6.4.8.2 until the optimal response is achieved. Figure 73 shows an ideal velocity response. There is only a small amount of overshoot and very little zero-speed noise.

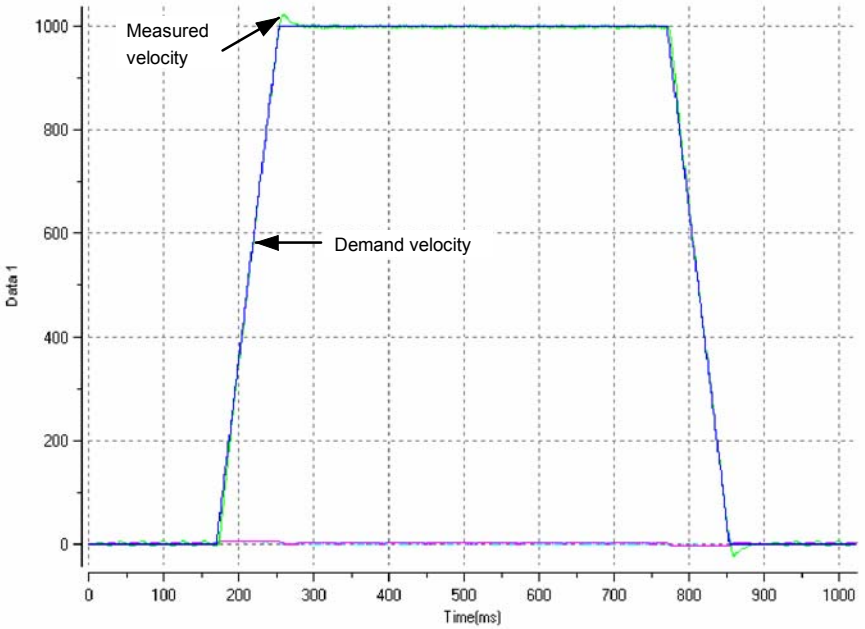


Figure 73 - Ideal velocity response

6.4.9 Performing test moves - continuous jog

This section tests the basic operation of the drive and motor by performing a continuous jog.

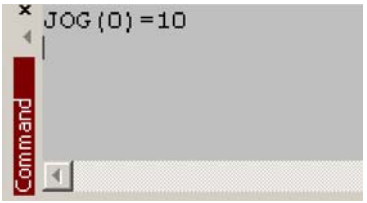
Note: To stop a move in progress, click the red stop button or the drive enable button on the toolbar. Alternatively, use the Mint WorkBench 'Red Stop Button' feature.

1. Check that the Drive enable button is pressed (down).

2. In the Toolbox, click the Edit & Debug icon.

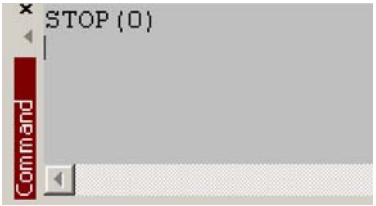
3. Click in the Command window.

4. Type:
   `JOG(0) = 10`



   This will cause the motor to move continuously at 10 units per second. In Mint WorkBench, look at the Spy window located on the right of the screen. Check that the axis tab is selected. The Spy window's Velocity display should show 10 (approximately). If there seems to be very little motor movement, it is probably due to the scale factor. In the Commissioning Wizard, on the Select Scale Factor page, if you did *not* adjust the scale factor then the current unit of movement is feedback counts per second. Depending on the motor's feedback device, 10 feedback counts per second could equate to a very small velocity. Issue another `JOG` command using a larger value, or use the Operating Mode Wizard to select a suitable scale factor (e.g. 4000 if the motor has a 1000 line encoder, or 10,000 for a 2500 line encoder).

5. To stop the test, type:
   `STOP(0)`



6. If you have finished testing click the Drive Enable button to disable the drive.

6.4.10 Performing test moves - relative positional move

This section tests the basic operation of the drive and motor by performing a positional move.

Note: To stop a move in progress, click the red stop button or the drive enable button on the toolbar. Alternatively, use the Mint WorkBench 'Red Stop Button' feature.

1. Check that the Drive enable button is pressed (down).

2. In the Toolbox, click the Edit & Debug icon.

3. Click in the Command window.

4. Type:
```
MOVER(0)=10
GO(0)
```
This will cause the motor to move to a position 10 units from its current position.

The move will stop when completed.

5. If you have finished testing click the Drive Enable button to disable the drive.

6.5 Further configuration

Mint WorkBench provides a number of other tools for testing and configuring the MotiFlex *e*100. Every tool is explained fully in the help file. Press F1 to display the help file, then navigate to the Mint WorkBench book. Inside this is the Toolbox book.

6.5.1 Parameters tool

The Parameters tool can be used to view or change most of the drive's parameters.

1. Click the Parameters icon in the Toolbox on the left of the screen.

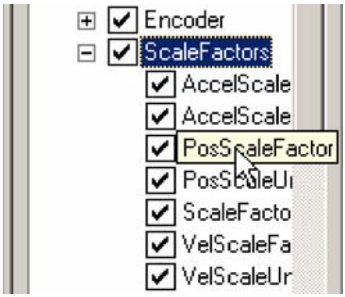
   The main area of the Mint WorkBench window displays the Parameters editor screen.

   Items listed with a grey RO icon are Read Only so cannot be changed.
   Items listed with a green FD icon are currently set to their Factory Default value.
   Items listed with a yellow C icon have been altered from their factory default value, either during the commissioning process or by the user.

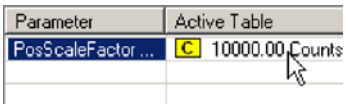
2. In the parameters tree, scroll to the required item. Click on the small + sign beside the item's name.

   The list will expand to show all items in the category.

   Click on the item you wish to edit.

3. The adjacent table will list the chosen item.

   Click in the Active Table cell and enter a value. This immediately sets the parameter, which will remain in the MotiFlex *e*100 until another value is defined. The icon to the left of the item will become yellow to indicate that the value has been changed.

   Many of the MotiFlex *e*100's parameters are set automatically by the Commissioning Wizard, or when tests are performed in the fine-tuning window.

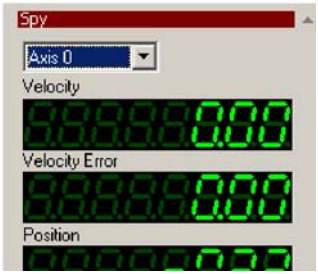
6.5.2 Spy window

The Spy window can be used to monitor and capture parameters in real-time. If you tried the test moves in section 6.4.9 or 6.4.10 then you have already seen the Spy window, as it is displayed in conjunction with Edit & Debug mode. See the Mint help file for full details of each tab.

1. Click the Edit & Debug icon in the Toolbox on the left of the screen.

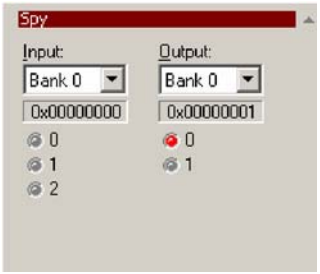
   The Spy Window is displayed on the right of the screen. Click on the tabs at the bottom of the window to select the required function.

2. The Axis tab displays the five most commonly monitored parameters, together with the state of special purpose inputs and outputs.

3. The I/O tab displays the state of all the digital inputs and outputs.

   Clicking on an output LED will toggle the output on/off.

4. The Monitor tab allows up to six parameters to be selected for monitoring.

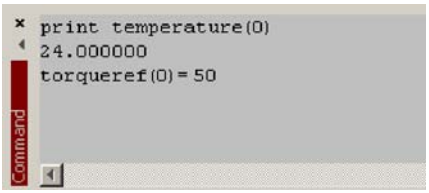
   Click in a drop down box to select a parameter.

   At the bottom of the Monitor tab, real-time data capture can be configured.

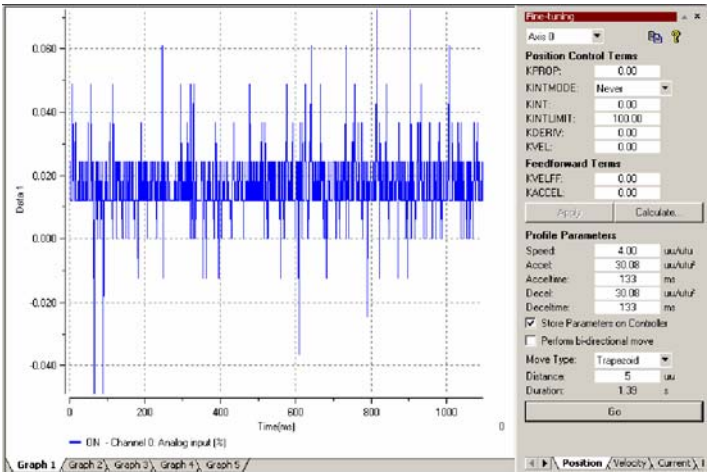
6.5.3 Other tools and windows

Remember, for help on each tool just press F1 to display the help file, then navigate to the Mint WorkBench book. Inside this is the Toolbox book.

- Edit & Debug Tool
  This tool provides a work area including the Command window and Output window. The Command window can be used to send immediate Mint commands to the MotiFlex *e*100. If you tried the test moves in section 6.4.9 or 6.4.10, then you have already used Edit & Debug mode. Press Ctrl+N to open a new Mint programming window.

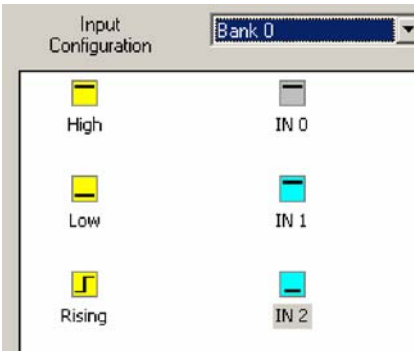


- Scope Tool
  Displays the capture screen. This screen is also shown when the Fine-tuning tool is selected.



- Digital I/O
  Allows you to configure the active states and special assignments for all the digital inputs and outputs.

  See section 5.3.2.1 or 5.3.3.1 for important details about using a digital input as a home input.



7.1 Introduction

This section explains common problems that may be encountered, together with possible solutions. If you want to know the meaning of the LED indicators, see section 7.2.

7.1.1 Problem diagnosis

If you have followed all the instructions in this manual in sequence, you should have few problems installing the MotiFlex *e*100. If you do have a problem, read this section first.
In Mint WorkBench, use the Error Log tool to view recent errors and then check the help file.
If you cannot solve the problem or the problem persists, the SupportMe feature can be used.

7.1.2 SupportMe feature

The SupportMe feature is available from the Help menu or by clicking the button on the motion toolbar. SupportMe can be used to gather information which can then be e-mailed, saved as a text file, or copied to another application. The PC must have e-mail facilities to use the e-mail feature. If you prefer to contact Baldor technical support by telephone or fax, contact details are provided at the front of this manual. Please have the following information ready:

- The serial number of your MotiFlex *e*100 (if known).
- Use the Help, SupportMe menu item in Mint WorkBench to view details about your system.
- The catalog and specification numbers of the motor that you are using.
- A clear description of what you are trying to do, for example trying to establish communications with Mint WorkBench or trying to perform fine-tuning.
- A clear description of the symptoms that you can observe, for example the Status LED, error messages displayed in Mint WorkBench, or errors reported by the Mint error keywords `ERRORREADCODE` or `ERRORREADNEXT`.
- The type of motion generated in the motor shaft.
- Give a list of any parameters that you have setup, for example the motor data you entered/selected in the Commissioning Wizard, the gain settings generated during the tuning process and any gain settings you have entered yourself.

7.1.3 Power-cycling the MotiFlex *e*100

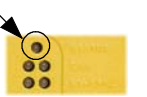
The term “Power-cycle the MotiFlex *e*100” is used in the Troubleshooting sections. This means:

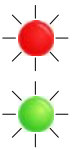
- Remove the AC supply (or shared DC bus supply).
- Remove the 24 VDC backup supply (if connected).
- Wait for the MotiFlex *e*100 to power down completely (the Status LED will turn off).
- Re-apply power.

7.2 MotiFlex *e*100 indicators

7.2.1 STATUS LED

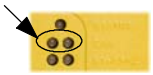
The Status LED indicates general MotiFlex *e*100 status information.



	Solid green: Drive enabled (normal operation).
	Flickering / blinking green: Firmware download / update in progress.
	Solid red: Drive disabled, but no errors are latched.
	Flashing red: Powerbase fault or error(s) present. The number of flashes indicates which error has occurred. For example, to display error 3 (overcurrent trip), the LED flashes 3 times at 0.1 second intervals, followed by a 0.5 second pause. The sequence is repeated continuously. Error code (no. of flashes) — Meaning 1 . . . . . DC bus overvoltage trip. 2 . . . . . PIM (power integration module) trip. 3 . . . . . Overcurrent trip. 4 . . . . . Overspeed trip. 5 . . . . . Feedback trip. 6 . . . . . Motor overload (I^2t) trip. 7 . . . . . Overtemperature trip. 8 . . . . . Drive overload (It) trip. 9 . . . . . Following error trip. 10 . . . . . Error input triggered. 11 . . . . . Phase search error. 12 . . . . . All other errors, including: Internal supply error, encoder supply error, parameter restore failure, power base not recognized. If multiple errors occur at the same time, the lowest numbered error code will be flashed. For example, a MotiFlex *e*100 which has tripped on both feedback error (code 5) and over-current error (code 3) will flash error code 3. If the drive is already displaying an error code when a new error with a lower code occurs, the drive will start flashing the new code. Note that undervoltage trip does not appear in the table because it is already indicated by the green/red flashing state. If an undervoltage trip occurs in conjunction with another error, the drive will flash the code of the additional error. Further details about error codes can be found in the Mint WorkBench help file. Press F1 and locate the *Error Handling* book.
	Alternate red/green flashing: Undervoltage warning (low DC bus voltage), but no errors are latched. The DC bus voltage has dropped below the powerbase undervoltage level (see `DRIVEBUSUNDERVOLTS`). This error will only be generated if the drive is in the enabled state. Check the AC power (or shared DC bus) is connected.

7.2.2 CAN LEDs

The CAN LEDs display the overall condition of the CANopen interface, once the startup sequence has completed. The LED codes conform to the CAN in Automation (CiA) DR303_3 indicator standard. The green LED indicates the state of the node's internal CANopen 'state machine'. The red LED indicates the state of the physical CANopen bus.

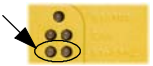


Green (run)	
	Off: Node initializing or not powered.
	1 flash: Node in STOPPED state. 3 flashes: Software is being downloaded to the node. Continuous flashing: Node in PRE-OPERATIONAL state. Flickering (very fast flashing): Auto-baudrate detection or LSS services in progress; flickers alternately with red LED.
	Continuously illuminated, not flashing: Node in OPERATIONAL state.

Red (error)	
	Off: No errors or not powered.
	1 flash: Warning - too many error frames. 2 flashes: Guard event or heartbeat event has occurred. 3 flashes: The SYNC message has not been received within the time-out period. Flickering (very fast flashing): Auto-baudrate detection or LSS services in progress; flickers alternately with green LED.
	Continuously illuminated, not flashing: The node's CAN controller is in the BUS OFF state, preventing it from taking part in any CANopen communication.

7.2.3 ETHERNET LEDs

The ETHERNET LEDs display the overall condition of the Ethernet interface once the startup sequence has completed. The LED codes conform to the Ethernet POWERLINK Standardization Group (EPSG) standard at the time of production.



Green (status)	
	Off: Node in NOT ACTIVE state. The controlled node is waiting to be triggered by the manager node.
	1 flash: Node in PRE-OPERATIONAL1 state. EPL mode is starting. 2 flashes: Node in PRE-OPERATIONAL2 state. EPL mode is starting. 3 flashes: Node in READY TO OPERATE state. The node is signalling its readiness to operate. Blinking (continuous flashing): Node in STOPPED state. The controlled node has been deactivated. Flickering (very fast flashing): Node in BASIC ETHERNET state (EPL is not operating, but other Ethernet protocols may be used).
	Continuously illuminated, not flashing: Node in OPERATIONAL state. EPL is operating normally.

Red (error)	
	Off: EPL is working correctly.
	Continuously illuminated: An error has occurred.

7.2.4 Communication

Status LED is off:

- Check that AC power (or shared DC bus supply) is present, or that the 24 VDC control circuit backup supply (if present) is connected correctly to connector X2 and is switched on.

ETHERNET LEDs blinking green and red simultaneously:

- Does the MotiFlex *e*100 have firmware in it? If you tried to download new firmware and the download failed, the controller may not have firmware. Download new firmware.

Mint WorkBench fails to detect the MotiFlex *e*100:

- Ensure that the MotiFlex *e*100 is powered and the Status LED is illuminated (see section 7.2.1).
- Check that the Ethernet or USB cable is connected between the PC and MotiFlex *e*100.
- Try an alternative cable or different port on the PC.
- In the "Search up to Node*xx*" option in Mint WorkBench's Select Controller dialog, check that the MotiFlex *e*100's node ID is not higher than the selected value, or search up to a greater node ID.
- For USB connections, check that the cable is properly connected. Check the USB connector socket pins for damage or sticking. Check that the USB device driver has been installed; a 'USB Motion Controller' device should be listed in Windows Device Manager.
- Check that the PC's Ethernet port has been correctly configured for TCP/IP operation (see section 6.2.4).

7.2.5 Power on

The Status LED is flashing red:

- The MotiFlex *e*100 has detected a motion error. Click the Error button on the motion toolbar to view a description of the error. Alternatively, select the Error Log tool to view a list of errors.
- Click the **Clear Errors** button on the motion toolbar.

7.2.6 Mint WorkBench

The Spy window does not update:

- The system refresh has been disabled. Go to the Tools, Options menu item, select the System tab and then choose a System Refresh Rate (500 ms is recommended).

Cannot communicate with the controller after downloading firmware:

- After firmware download, always power cycle the MotiFlex *e*100.

Mint WorkBench loses contact with MotiFlex *e*100 while connected using USB:

- Check that the MotiFlex *e*100 is powered.
- Check that a 'USB Motion Controller' device is listed in Windows Device Manager. If not, there could be a problem with the PC's USB interface.

7.2.7 Tuning

Cannot enable the MotiFlex *e*100 because there is an error 10010:

- Check the drive enable input on connector X3 pins 9 and 19 is connected and powered correctly.

When the MotiFlex *e*100 is enabled the motor is unstable:

- Check that the load is firmly coupled to the motor.
- Use the Mint WorkBench Drive Setup Wizard to confirm that the correct motor data has been entered.
- Use the Mint WorkBench Autotune Wizard to retune the motor.
- If the motor is still unstable, select the Mint WorkBench Autotune Wizard once more. Click **Options...**. On the Bandwidth tab, move the Current and/or Position and Speed Control sliders to a slower position to select to a lower bandwidth. Click **OK** to exit and then start the Autotune Wizard again.

7.2.8 Ethernet

Cannot connect to the drive over TCP/IP:

- Check that there is not an EPL manager node (for example NextMove *e*100 with node ID 240) on the network. If there is a manager node on the network, then an EPL compatible router must be used to allow TCP/IP communication on the EPL network.
- Check that the PC's Ethernet adapter has been correctly configured, as described in section 6.2.4.

The Ethernet POWERLINK network does not seem to be operating correctly:

- Confirm that only one device on the network is set to be the Ethernet POWERLINK manager node (node ID 240, selector switches LO = F, HI = 0).
- Confirm that the reference source on all controlled nodes has been set to EPL in the Mint WorkBench Operating Mode Wizard, and that the manager node has been configured correctly. For a NextMove *e*100 manager node, this requires the System Config Wizard to be used in Mint WorkBench.
- Confirm that each device on the network has a different node ID.
- Confirm that there are no more than 10 'daisy-chained' devices on each branch of the network.

7.2.9 CANopen

The CANopen bus is 'passive':

This means that the internal CAN controller in the MotiFlex *e*100 is experiencing a number of Tx and/or Rx errors, greater than the passive threshold of 127. Check:

- 12-24 VDC is being applied between pin 9 (+24 V) and pin 6 or 3 (0 V) of the CAN connector, to power the opto-isolators.
- There is at least one other CANopen node in the network.
- The network is terminated *only* at the ends, not at intermediate nodes.
- All nodes on the network are running at the same baud rate.
- All nodes have been assigned a unique node ID.
- The integrity of the CAN cables.

The MotiFlex *e*100 should recover from the 'passive' state once the problem has been rectified (this may take several seconds).

The CANopen bus is 'off':

This means that the internal CAN controller in the MotiFlex *e*100 has experienced a fatal number of Tx and/or Rx errors, greater than the off threshold of 255. At this point the node will have switched itself to a state whereby it cannot influence the bus. Check:

- 12-24 VDC is being applied between pin 9 (+24 V) and pin 6 or 3 (0 V) of the CAN connector, to power the opto-isolators.
- There is at least one other CANopen node in the network.
- The network is terminated *only* at the ends, not at intermediate nodes.
- All nodes on the network are running at the same baud rate.
- All nodes have been assigned a unique node ID.
- The integrity of the CAN cables.

To recover from the 'off' state, the source of the errors must be removed and the bus then reset. This can be done using the Mint `BUSRESET` keyword, or by resetting the MotiFlex *e*100.

The Manager node cannot scan / recognize a node on the network using the Mint `NODESCAN` keyword:

Assuming that the network is working correctly (see previous symptoms) and the bus is in an 'Operational' state, check:

- Only nodes that conform to DS401, DS403 and other Baldor CANopen nodes are recognized by the Mint `NODESCAN` keyword. Other types of node will be identified with a type "unknown" (255) when using the Mint `NODETYPE` keyword.
- Check that the node in question has been assigned a unique node ID.
- The node must support the node guarding process. MotiFlex *e*100 does not support the Heartbeat process.
- Try power-cycling the node in question.

If the node in question does not conform to DS401 or DS403 and is not a Baldor CANopen node, communication is still possible using a set of general purpose Mint keywords. See the Mint help file for further details.

The node has been successfully scanned / recognized by the Manager node, but communication is still not possible:

For communication to be allowed, a connection must be made to a node after it has been scanned:

- Baldor controller nodes are automatically connected to after being scanned.
- Nodes that conform to DS401, DS403 must have the connections made manually using the Mint `CONNECT` keyword.

If a connection attempt using `CONNECT` fails then it may be because the node being connected to does not support an object which needs to be accessed in order to setup the connection.

8.1 Introduction

This section provides technical specifications for the MotiFlex *e*100.

8.2 AC input

8.2.1 AC input voltage (X1) - all models

All models	**Unit**	**AC input**
		3Φ, 50 Hz / 60 Hz
Nominal input voltage	**VAC**	230 or 480
Minimum input voltage		180
Maximum input voltage		528
Nominal DC bus voltage @ 230 VAC input @ 480 VAC input	**VDC**	 325 678

8.2.2 AC input current (X1), DC bus not shared - all models

Tables 7 and 8 show a range of typical AC input currents at typical motor output currents. The *Typical AC supply current at full load* is calculated using an AC input power factor of 0.7 and a motor output power factor of 0.85. It is highly recommended that fuses are used instead of circuit breakers. Circuit breakers should only be used when absolutely necessary. Tables 7 and 8 describe the recommended fuses and circuit breakers to be used for AC power connections.

Full load output current rating not exceeding (A)	Typical AC supply current at full load (A)	Input fuse	Circuit breaker (C-type)
1.5	1.8	Ferraz Shawmut: A60Q5-2, 5 A (E217400)	4 A
3	3.6	Ferraz Shawmut: A60Q8-2, 8 A (T218425)	6 A
4	4.9	Ferraz Shawmut: A60Q8-2, 8 A (T218425)	10 A
5.5	6.7	Ferraz Shawmut: A60Q10-2, 10 A (Z212289)	10 A
8.5	10.3	Ferraz Shawmut: A60Q15-2, 15 A (X213322)	16 A
9	10.9	Ferraz Shawmut: A60Q15-2, 15 A (X213322)	16 A
10	12.1	Ferraz Shawmut: A60Q20-2, 20 A (B214338)	16 A
11	13.4	Ferraz Shawmut: A60Q20-2, 20 A (B214338)	20 A
13	15.8	Ferraz Shawmut: A60Q25-2, 25 A (Z214842)	20 A
17.5	21.25	Ferraz Shawmut: A60Q25-2, 25 A (Z214842)	25 A
18.5	22.5	Ferraz Shawmut: A60Q25-2, 25 A (Z214842)	25 A
22	26.7	Ferraz Shawmut: A60Q30-2, 30 A (E215859)	32 A

Table 7 - AC input current and protection device ratings - 1.5 A ~ 16 A models

Full load output current rating not exceeding (A)	AC supply current at full load (A)	Input fuse	Circuit breaker (B-type)
10	12.1	Ferraz Shawmut: A60Q20-2, 20 A (B214338)	16 A
14	17	Ferraz Shawmut: A60Q20-2, 20 A (B214338)	20 A
15	18.2	Ferraz Shawmut: A60Q25-2, 25 A (Z214842) or 6.600 CP URD 22x58/25 (B093956)	25 A
21	25.5	Ferraz Shawmut: A60Q30-2, 30 A (E215859) or 6.600 CP URD 22x58/32 (Z094828)	32 A
24	29	Ferraz Shawmut: A60Q35-2, 35 A (J216369) or 6.600 CP URD 22x58/32 (Z094828)	40 A
29	35.2	Ferraz Shawmut: A60Q40-2, 40 A (N216879) or 6.600 CP URD 22x58/40 (S094822)	40 A
33.5	40.7	Ferraz Shawmut: 6.600 CP URD 22x58/50 (W094779)	50 A
48	54.6	Cooper Bussmann: LPN-RK-80SP	80 A
65	78.9	Cooper Bussmann: LPN-RK-80SP	80 A

Table 8 - AC input current and protection device ratings - 21 A ~ 65 A models

8.2.3 AC input current (X1), DC bus sharing - all models

When the MotiFlex *e*100 is sharing its DC bus, it becomes critical to consider the overall current being derived from the drive's internal power supply. This includes the current required to drive its own motor (if present), and the current required by the other drives sharing its DC bus.

The following ratings assume that the source drive is itself driving a motor at the drive's rated current output.

8.2.3.1 Rating adjustment when sharing DC bus - 1.5 A model

Note: A 1.2 mH line reactor must be used when DC bus sharing.

Temperature	Switching frequency	Maximum AC input supply current (RMS)		
		Continuous	3 s overload	60 s overload
45 °C (113 °F)	4 kHz	10 A	16.5 A	13.5 A
	8 kHz			
	16 kHz			
55 °C (131 °F)	4 kHz	7.5 A		
	8 kHz			
	16 kHz			

Table 9 - Continuous current ratings for 1.5 A model, sharing DC bus

8.2.3.2 Rating adjustment when sharing DC bus - 3 A model

Note: A 1.2 mH line reactor must be used when DC bus sharing.

Temperature	Switching frequency	Maximum AC input supply current (RMS)		
		Continuous	3 s overload	60 s overload
45 °C (113 °F)	4 kHz	10 A	16.5 A	13.5 A
	8 kHz			
	16 kHz			
55 °C (131 °F)	4 kHz	7.5 A		
	8 kHz			
	16 kHz			

Table 10 - Continuous current ratings for 3 A model, sharing DC bus

8.2.3.3 Rating adjustment when sharing DC bus - 6 A model

Note: A 1.2 mH line reactor must be used when DC bus sharing.

Temperature	Switching frequency	Maximum AC input supply current (RMS)		
		Continuous	3 s overload	60 s overload
45 °C (113 °F)	**4 kHz**	14 A	21 A	17 A
	8 kHz	14 A		
	16 kHz	7.5 A		
55 °C (131 °F)	**4 kHz**	8.4 A		
	8 kHz	8.4 A		
	16 kHz	4.5 A		

Table 11 - Continuous current ratings for 6 A model, sharing DC bus

8.2.3.4 Rating adjustment when sharing DC bus - 10.5 A model

Note: A 0.8 mH line reactor must be used when DC bus sharing.

Temperature	Switching frequency	Maximum AC input supply current (RMS)		
		Continuous	3 s overload	60 s overload
45 °C (113 °F)	**4 kHz**	20 A	36 A	27 A
	8 kHz	18 A		
	16 kHz	13.5 A		
55 °C (131 °F)	**4 kHz**	17 A		
	8 kHz	15 A		
	16 kHz	9 A		

Table 12 - Continuous current ratings for 10.5 A model, sharing DC bus

8.2.3.5 Rating adjustment when sharing DC bus - 16 A model

Note: A 0.8 mH line reactor must be used when DC bus sharing.

Temperature	Switching frequency	Maximum AC input supply current (RMS)		
		Continuous	3 s overload	60 s overload
45 °C (113 °F)	**4 kHz**	22 A	42 A	33 A
	8 kHz	20 A		
	16 kHz	13.5 A		
55 °C (131 °F)	**4 kHz**	18 A		
	8 kHz	17.5 A		
	16 kHz	10 A		

Table 13 - Continuous current ratings for 16 A model, sharing DC bus

8.2.3.6 Rating adjustment when sharing DC bus - 21 A model

Note: A 0.5 mH line reactor must be used when DC bus sharing.

Temperature	Switching frequency	Maximum AC input supply current (RMS)		
		Continuous	3 s overload	60 s overload
45 °C (113 °F)	**4 kHz**	30 A	68 A	45 A
	8 kHz	26 A	60 A	39 A
	16 kHz	19 A	57 A	30 A
55 °C (131 °F)	**4 kHz**	23.8 A	47.6 A	31.5 A
	8 kHz	21 A	42 A	27.3 A
	16 kHz	13.3 A	39.9 A	21 A

Table 14 - Continuous current ratings for 21 A model, sharing DC bus

8.2.3.7 Rating adjustment when sharing DC bus - 26 A model

Note: A 0.5 mH line reactor must be used when DC bus sharing.

Temperature	Switching frequency	Maximum AC input supply current (RMS)		
		Continuous	3 s overload	60 s overload
45 °C (113 °F)	**4 kHz**	34 A	80 A	51 A
	8 kHz	28 A	70 A	42 A
	16 kHz	19 A	57 A	30 A
55 °C (131 °F)	**4 kHz**	28 A	56 A	35.7 A
	8 kHz	24.5 A	49 A	29.4 A
	16 kHz	13.3 A	39.9 A	21 A

Table 15 - Continuous current ratings for 26 A model, sharing DC bus

8.2.3.8 Rating adjustment when sharing DC bus - 33.5 A model

Note: A 0.5 mH line reactor must be used when DC bus sharing.

Temperature	Switching frequency	Maximum AC input supply current (RMS)		
		Continuous	3 s overload	60 s overload
45 °C (113 °F)	**4 kHz**	34 A	80 A	51 A
	8 kHz	28 A	70 A	42 A
	16 kHz	19 A	57 A	30 A
55 °C (131 °F)	**4 kHz**	28 A	56 A	35.7 A
	8 kHz	24.5 A	49 A	29.4 A
	16 kHz	13.3 A	39.9 A	21 A

Table 16 - Continuous current ratings for 33.5 A model, sharing DC bus

8.2.3.9 Rating adjustment when sharing DC bus - 48 A model

Note: A 0.5 mH line reactor must be used when DC bus sharing.

Temperature	Switching frequency	Maximum AC input supply current (RMS)		
		Continuous	3 s overload	60 s overload
45 °C (113 °F)	**4 kHz**	66	132	99
	8 kHz	66	132	99
55 °C (131 °F)	**4 kHz**	66	132	99
	8 kHz	66	132	99

Table 17 - Continuous current ratings for 48 A model, sharing DC bus

8.2.3.10 Rating adjustment when sharing DC bus - 65 A model

Note: A 0.5 mH line reactor must be used when DC bus sharing.

Temperature	Switching frequency	Maximum AC input supply current (RMS)		
		Continuous	3 s overload	60 s overload
45 °C (113 °F)	**4 kHz**	66	132	99
	8 kHz	66	132	99
55 °C (131 °F)	**4 kHz**	66	132	99
	8 kHz	66	132	99

Table 18 - Continuous current ratings for 65 A model, sharing DC bus

8.2.4 Recommended fuses and circuit breakers when sharing the DC bus

When a drive is being used as the source drive to power other drives linked by the DC bus (see sections 3.2.4 and 3.5), the fuse rating will need to be increased to allow for the total input current. This is summarized in the following table:

Max. cont. AC input current less than (A_{RMS})	Input fuse for maximum continuous input current	Circuit breaker (C-type)
10 A	Ferraz Shawmut: A60Q10-2, 10 A (Z212289)	10 A
14 A	Ferraz Shawmut: A60Q20-2, 20 A (B214338)	16 A
20 A	Ferraz Shawmut: A60Q25-2, 25 A (Z214842)	25 A
22 A	Ferraz Shawmut: A60Q25-2, 25 A (Z214842)	25 A

Table 19 - Protection device ratings when sharing the DC bus - 1.5 A ~ 16 A models

Max. cont. AC input current less than (A_{RMS})	Input fuse for maximum continuous input current	Circuit breaker (B-type)
14 A	Ferraz Shawmut: A60Q20-2, 20 A (B214338)	20 A
25 A	Ferraz Shawmut: A60Q30-2, 30 A (E215859) or 6.600 CP URD 22x58/32 (Z094828)	32 A
28 A	Ferraz Shawmut: A60Q35-2, 35 A (J216369) or 6.600 CP URD 22x58/32 (Z094828)	32 A
35 A	Ferraz Shawmut: A60Q40-2, 40 A (N216879) or 6.600 CP URD 22x58/40 (S094822)	40 A
40 A	Ferraz Shawmut: 6.600 CP URD 22x58/50 (W094779)	50 A
80 A	Cooper Bussmann: LPN-RK-80SP	Not recommended.
80 A	Cooper Bussmann: LPN-RK-80SP	Not recommended.

Table 20 - Protection device ratings when sharing the DC bus - 21 A ~ 65 A models

Recommended fuses are based on 25 °C (77 °F) ambient, maximum continuous control output current and no harmonic current. Earth/ground wires must be the same gauge, or larger, than the Line wires.

UL compliance can only be achieved when using the recommended fuses. The use of circuit breakers does not guarantee UL compliance and provides protection for the wiring only, not the MotiFlex *e*100.

8.2.5 Power, power factor and crest factor - 1.5 A ~ 16 A models

The relationship between input current and power, power factor and crest factor is shown in Figure 74 (with no line reactor) and Figures 75 to 78 (with line reactor).

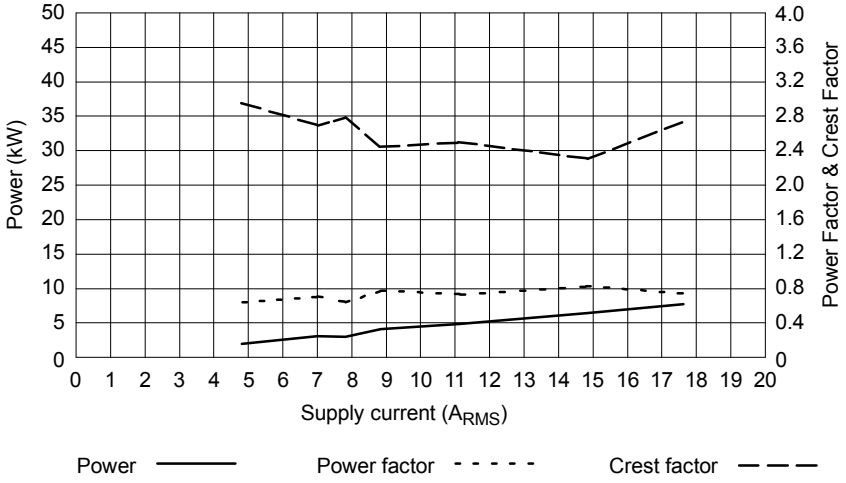


Figure 74 - Power, power factor and crest factor (no line reactor) - 1.5 A ~ 16 A models

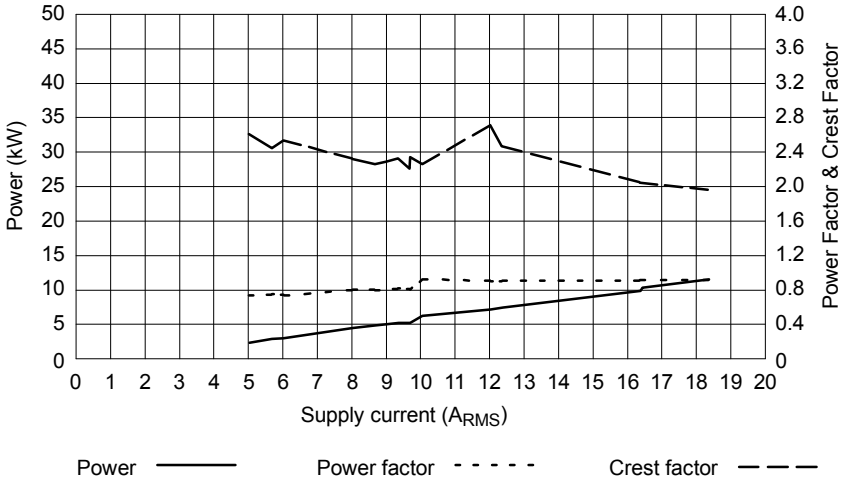


Figure 75 - Power, power factor and crest factor (1.2 mH line reactor) - 1.5 A & 3 A models

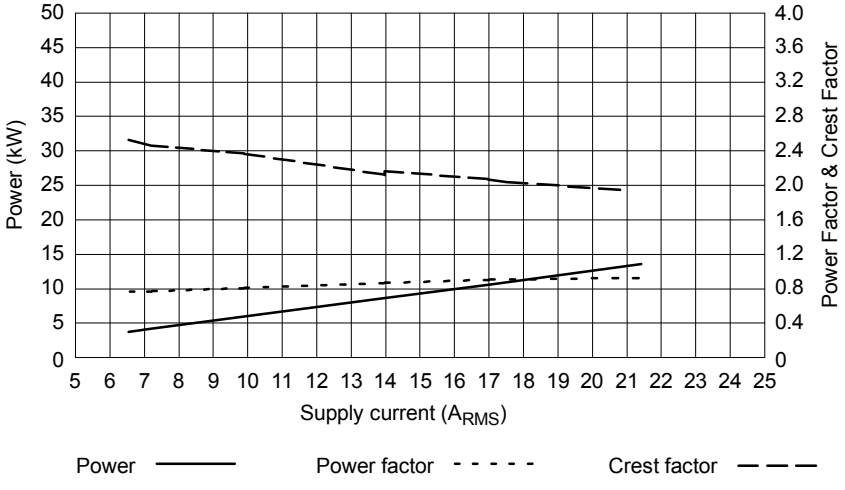


Figure 76 - Power, power factor and crest factor (1.2 mH line reactor) - 6 A model

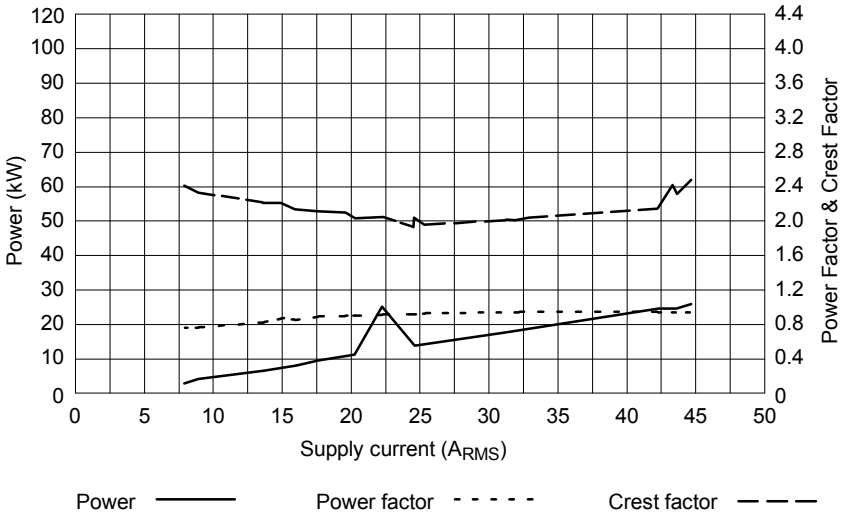


Figure 77 - Power, power factor and crest factor (0.8 mH line reactor) - 10.5 A model

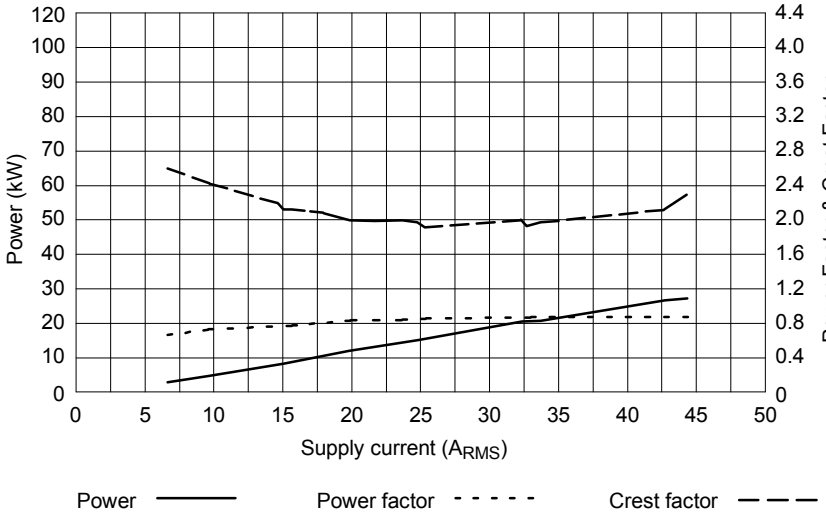


Figure 78 - Power, power factor and crest factor (0.8 mH line reactor) - 16 A model

8.2.6 Power, power factor and crest factor - 21 A model

The relationship between input current and power, power factor and crest factor is shown in Figure 79 (with no line reactor) and Figure 80 (with 0.5 mH line reactor).

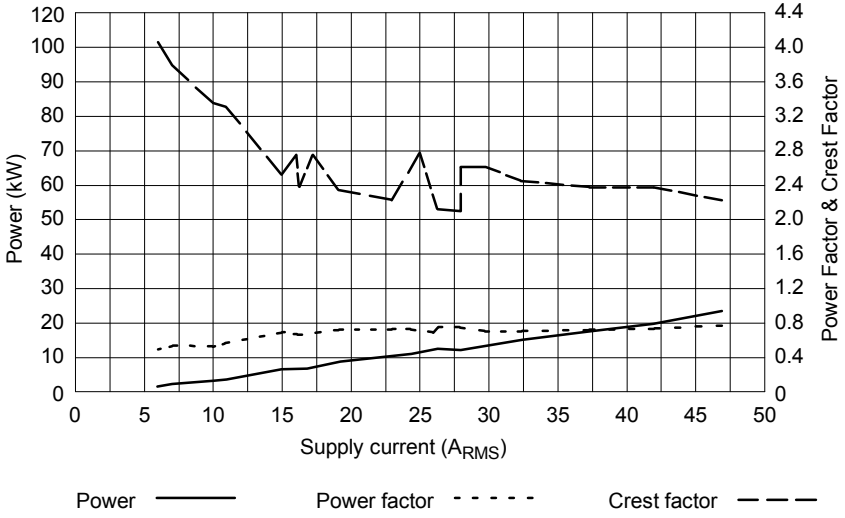


Figure 79 - Power, power factor and crest factor (no line reactor) - 21 A model

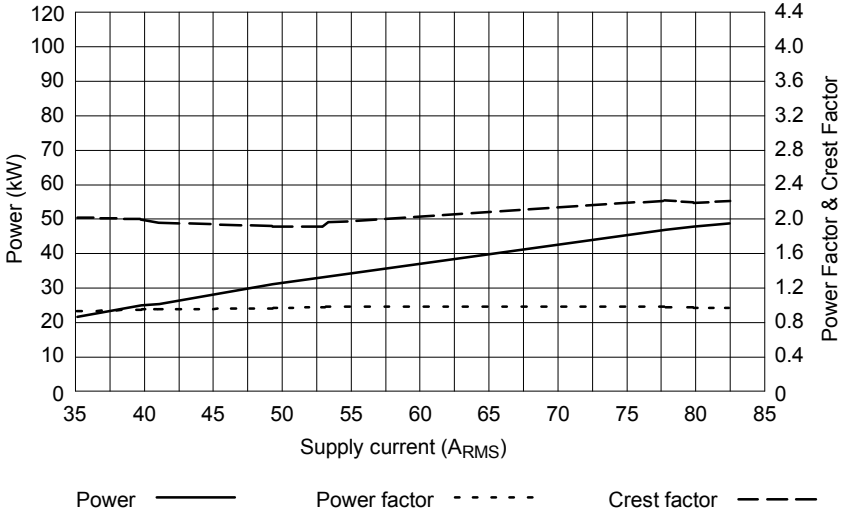


Figure 80 - Power, power factor and crest factor (0.5 mH line reactor) - 21 A model

8.2.7 Power, power factor and crest factor - 26 A & 33.5 A models

The relationship between input current and power, power factor and crest factor is shown in Figure 81 (with no line reactor) and Figure 82 (with 0.5 mH line reactor).

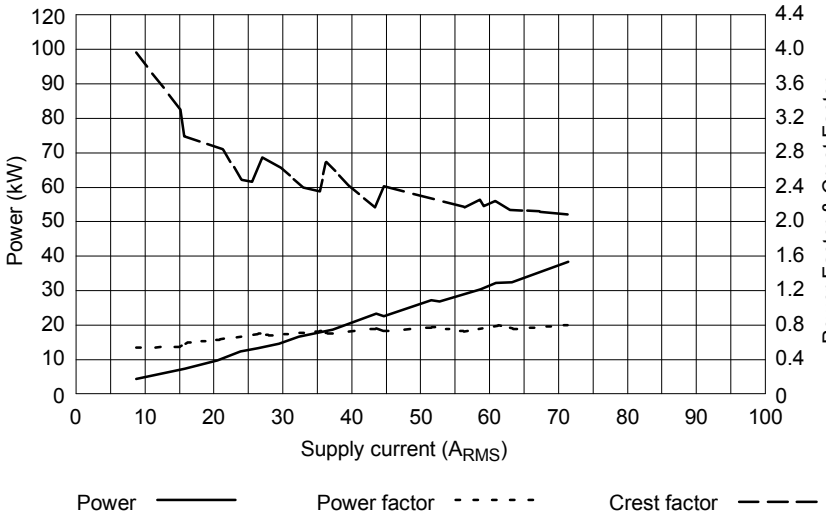


Figure 81 - Power, power factor and crest factor (no line reactor) - 26 A & 33.5 A models

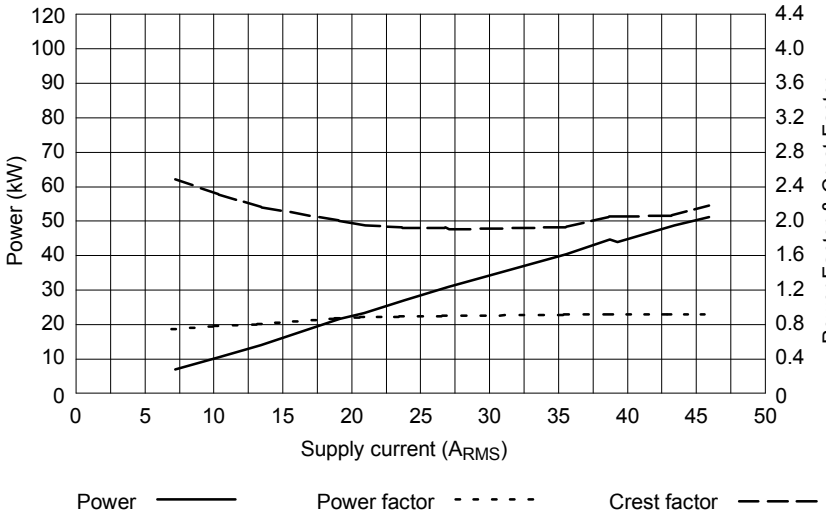


Figure 82 - Power, power factor and crest factor (0.5 mH line reactor) - 26 A & 33.5 A models

8.2.8 Power, power factor and crest factor - 48 A & 65 A models

The relationship between input current and power, power factor and crest factor is shown in Figure 83 (with no line reactor) and Figure 84 (with 0.5 mH line reactor).

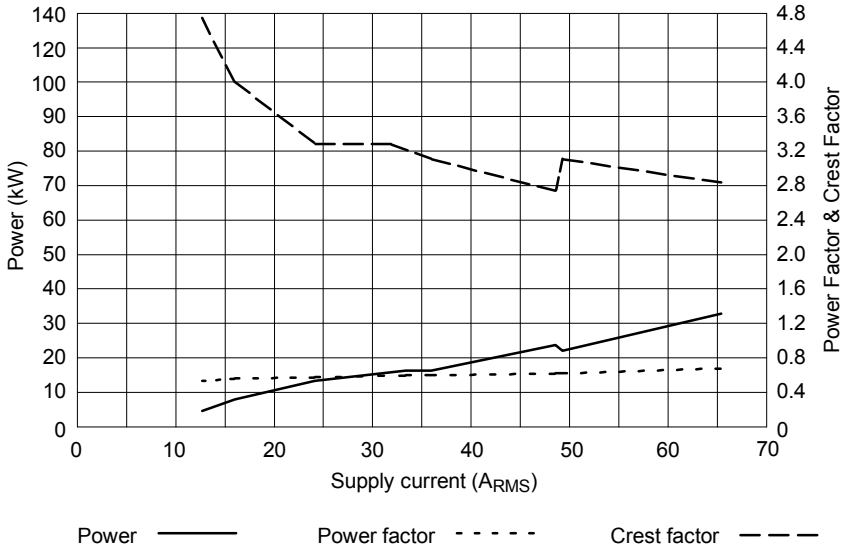


Figure 83 - Power, power factor and crest factor (no line reactor) - 48 A & 65 A models

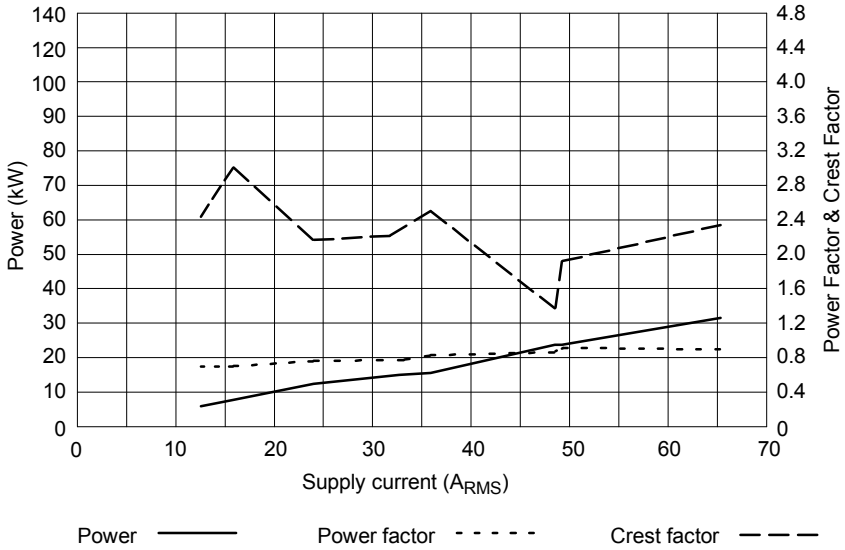


Figure 84 - Power, power factor and crest factor (0.5 mH line reactor) - 48 A & 65 A models

8.3 Motor output

8.3.1 Motor output power (X1) - 1.5 A ~ 16 A models

	Unit	1.5 A	3 A	6 A	10.5 A	16 A
Nominal phase current	A_{RMS}	1.5	3	6	10.5	16
Nominal output power @ 415 V	**kVA**	1.08	2.16	4.31	7.55	11.50
Output voltage range (line-line) @ VDC-bus = 600 V	V_{RMS}	0 - 430				
Output frequency	**Hz**	0 - 2000				
Output dV/dt at drive, phase-phase at drive, phase-ground at motor (using 20 m cable), phase-phase at motor (using 20 m cable), phase-ground	**kV/µs**	2 1.1 1.9 1.8				
Nominal switching frequencies	**kHz**	4.0, 8.0, 16.0				
Minimum motor inductance (per winding)	**mH**	1				
Efficiency	**%**	>95				

8.3.2 Motor output power (X1) - 21A ~ 33.5 A models

	Unit	21 A	26 A	33.5 A
Nominal phase current	A_{RMS}	21	26	33.5
Nominal output power @ 415 V, 3Φ input	**kVA**	15.10	18.69	24.08
Output voltage range (line-line) @ VDC-bus = 600 V	V_{RMS}	0 - 430		
Output frequency	**Hz**	0 - 2000		
Output dV/dt at drive, phase-phase at drive, phase-ground at motor (using 20 m cable), phase-phase at motor (using 20 m cable), phase-ground	**kV/µs**	2 1.1 1.9 1.8		
Nominal switching frequencies	**kHz**	4.0, 8.0, 16.0 *		
Minimum motor inductance (per winding)	**mH**	1		
Efficiency	**%**	>95		

* 16 kHz not available on 33.5 A model.

8.3.3 Motor output power (X1) - 48 A ~ 65 A models

	Unit	48 A	65 A
Nominal phase current	A_{RMS}	48	65
Nominal output power @ 415 V, 3Φ input	**kVA**	32.5	46.72
Output voltage range (line-line) @ VDC-bus = 600 V	V_{RMS}	0 - 430	
Output frequency	**Hz**	0 - 2000	
Output dV/dt at drive, phase-phase at drive, phase-ground at motor (using 20 m cable), phase-phase at motor (using 20 m cable), phase-ground	**kV/µs**	 2 1.1 1.9 1.8	
Nominal switching frequencies	**kHz**	4.0, 8.0	
Minimum motor inductance (per winding)	**mH**	1	
Efficiency	**%**	>95	

8.3.4 Motor output uprating and derating

The continuous output current available from the MotiFlex *e*100 will often differ from the nominal value suggested by the model name. For example, depending on the chosen overload type and switching frequency, the continuous output rating of a 16 A model can be derated to as little as 8.5 A, or uprated to as much as 22 A. When operating a motor at very low speeds or holding it stationary, other ratings apply since these conditions represent abnormal operating modes for the MotiFlex *e*100. In addition to these rating adjustments, if the MotiFlex *e*100 is operating in an ambient temperature greater than 45 ºC (113 ºF), a further derating must be applied. The choice of overload rating and switching frequency can be selected using the Drive Setup Wizard in Mint WorkBench, or by using the `DRIVERATINGZONE` keyword. See the Mint help file for details.

8.3.5 Motor output rating adjustment - 1.5 A model

The continuous current rating of the MotiFlex *e*100 is affected by the chosen overload type and switching frequency, as shown in Table 21. These settings can be selected in the Mint WorkBench Drive Setup Wizard - see the Mint help file for details.

	Servo motor		Induction motor		Low speed output (< 2 Hz)	Stationary: DC output (any phase)
	300%, 3 s overload	200%, 3 s overload	150%, 60 s overload	110%, 60 s overload		
4 kHz	1.15 A	1.7 A	2.2 A	3 A	5.3 A	7.5 A (DC)
8 kHz	1.15 A	1.5 A	2 A	2.7 A	4.25 A	6 A (DC)
16 kHz	1.15 A	1.5 A	2 A	2.7 A	2.6 A	3.7 A (DC)

Table 21 - Continuous current ratings for 1.5 A model

The continuous current ratings shown in Table 21 must be derated if the drive is operating in an ambient temperature between 45 °C (113 °F) and the absolute maximum operating temperature of 55 °C (131 °F):

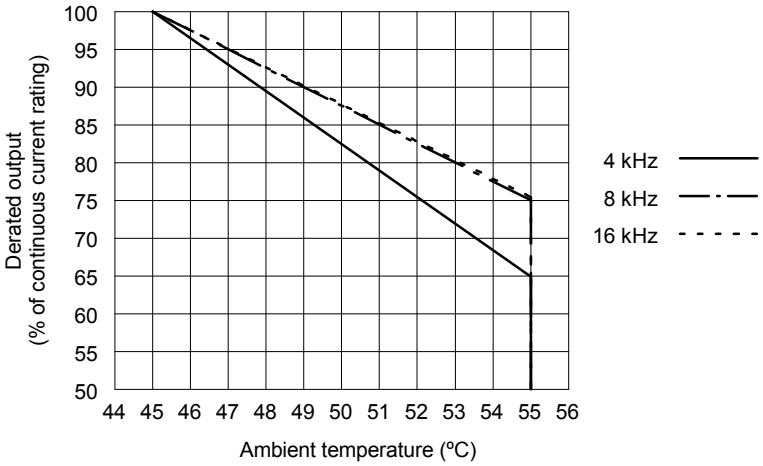


Figure 85 - Temperature derating for 1.5 A model

8.3.6 Motor output rating adjustment - 3 A model

The continuous current rating of the MotiFlex *e*100 is affected by the chosen overload type and switching frequency, as shown in Table 22. These settings can be selected in the Mint WorkBench Drive Setup Wizard - see the Mint help file for details.

	Servo motor		Induction motor		Low speed output (< 2 Hz)	Stationary: DC output (any phase)
	300%, 3 s overload	200%, 3 s overload	150%, 60 s overload	110%, 60 s overload		
4 kHz	2.75 A	4 A	5 A	5.5 A	5.3 A	7.5 A (DC)
8 kHz	2.75 A	3 A	3.8 A	4.5 A	4.25 A	6 A (DC)
16 kHz	2.7 A	3 A	3.8 A	4.5 A	2.6 A	3.7 A (DC)

Table 22 - Continuous current ratings for 3 A model

The continuous current ratings shown in Table 22 must be derated if the drive is operating in an ambient temperature between 45 °C (113 °F) and the absolute maximum operating temperature of 55 °C (131 °F):

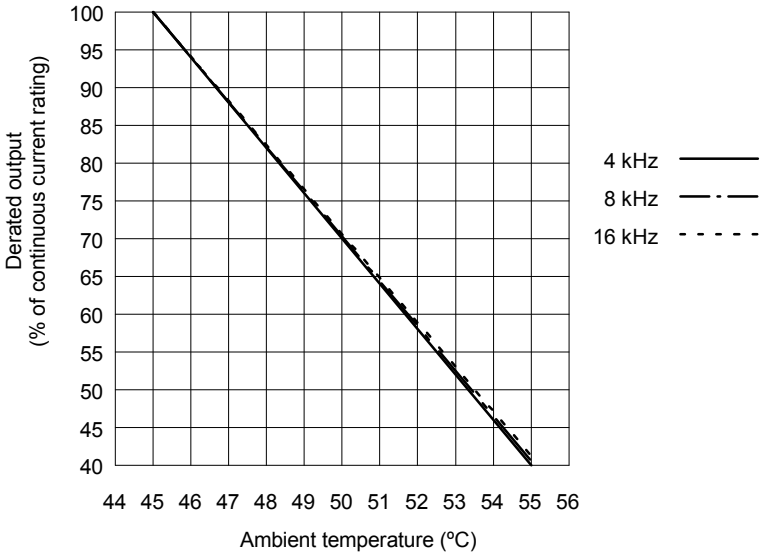


Figure 86 - Temperature derating for 3 A model

CAUTION

When sharing the DC bus, it becomes critical to consider the overall power being derived from the drive's internal power supply. See section 8.2.3.

8.3.7 Motor output rating adjustment - 6 A model

The continuous current rating of the MotiFlex *e*100 is affected by the chosen overload type and switching frequency, as shown in Table 23. These settings can be selected in the Mint WorkBench Drive Setup Wizard - see the Mint help file for details.

	Servo motor		Induction motor		Low speed output (< 2 Hz)	Stationary: DC output (any phase)
	300%, 3 s overload	200%, 3 s overload	150%, 60 s overload	110%, 60 s overload		
4 kHz	5 A	7.5 A	9 A	10 A	9.8 A	13.9 A (DC)
8 kHz	4.5 A	6 A	7 A	8 A	8 A	11.4 A (DC)
16 kHz	3 A	4 A	5 A	5.5 A	5.2 A	7.4 A (DC)

Table 23 - Continuous current ratings for 6 A model

The continuous current ratings shown in Table 23 must be derated if the drive is operating in an ambient temperature between 45 °C (113 °F) and the absolute maximum operating temperature of 55 °C (131 °F):

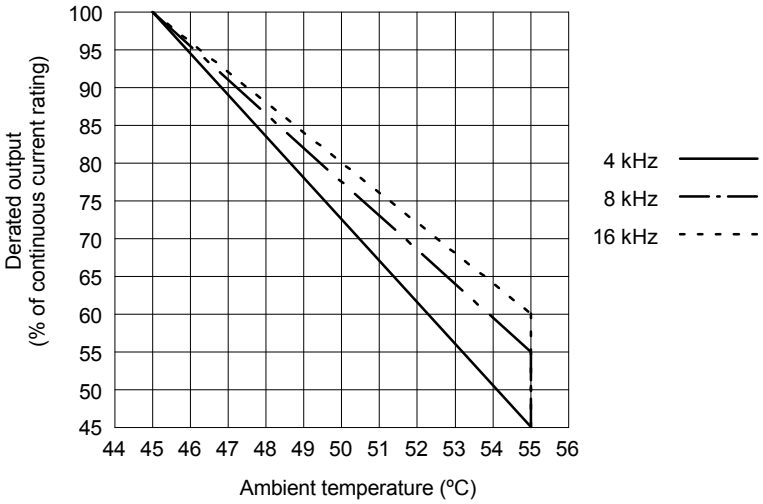


Figure 87 - Temperature derating for 6 A model

CAUTION

When sharing the DC bus, it becomes critical to consider the overall power being derived from the drive's internal power supply. See section 8.2.3.

8.3.8 Motor output rating adjustment - 10.5 A model

The continuous current rating of the MotiFlex *e*100 is affected by the chosen overload type and switching frequency, as shown in Table 24. These settings can be selected in the Mint WorkBench Drive Setup Wizard - see the Mint help file for details.

	Servo motor		Induction motor		Low speed output (< 2 Hz)	Stationary: DC output (any phase)
	300%, 3 s overload	200%, 3 s overload	150%, 60 s overload	110%, 60 s overload		
4 kHz	8 A	12 A	16 A	18.5 A	9.8 A	13.9 A (DC)
8 kHz	7.33 A	10.5 A	13 A	15 A	8 A	11.4 A (DC)
16 kHz	5 A	7.5 A	8.5 A	9.5 A	5.2 A	7.4 A (DC)

Table 24 - Continuous current ratings for 10.5 A model

The continuous current ratings shown in Table 24 must be derated if the drive is operating in an ambient temperature between 45 °C (113 °F) and the absolute maximum operating temperature of 55 °C (131 °F):

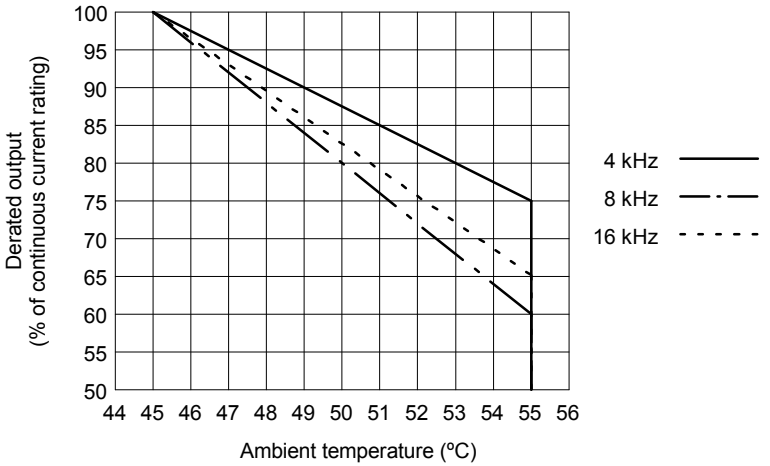


Figure 88 - Temperature derating for 10.5 A model

CAUTION

When sharing the DC bus, it becomes critical to consider the overall power being derived from the drive's internal power supply. See section 8.2.3.

8.3.9 Motor output rating adjustment - 16 A model

The continuous current rating of the MotiFlex *e*100 is affected by the chosen overload type and switching frequency, as shown in Table 25. These settings can be selected in the Mint WorkBench Drive Setup Wizard - see the Mint help file for details.

	Servo motor		Induction motor		Low speed output (< 2 Hz)	Stationary: DC output (any phase)
	300%, 3 s overload	200%, 3 s overload	150%, 60 s overload	110%, 60 s overload		
4 kHz	12 A	18 A	20 A	22 A	17 A	24 A (DC)
8 kHz	12 A	16 A	16 A	17 A	13.8 A	19.5 A (DC)
16 kHz	8.5 A	10 A	9 A	10 A	5.7 A	8.1 A (DC)

Table 25 - Continuous current ratings for 16 A model

The continuous current ratings shown in Table 25 must be derated if the drive is operating in an ambient temperature between 45 °C (113 °F) and the absolute maximum operating temperature of 55 °C (131 °F):

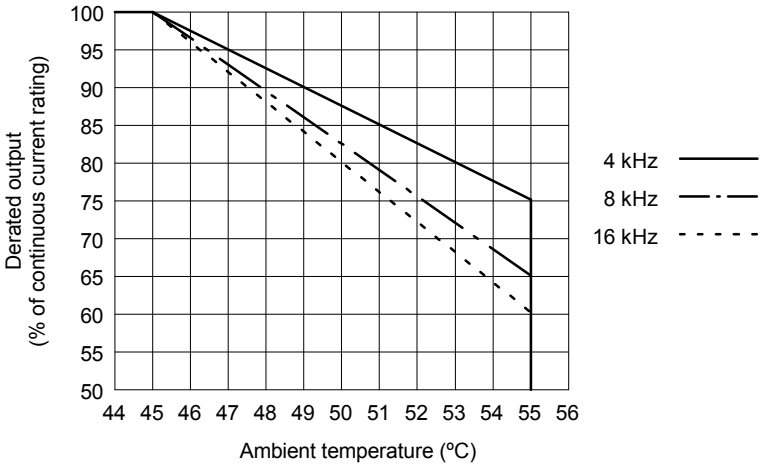


Figure 89 - Temperature derating for 16 A model

CAUTION

When sharing the DC bus, it becomes critical to consider the overall power being derived from the drive's internal power supply. See section 8.2.3.

8.3.10 Motor output rating adjustment - 21 A model

The continuous current rating of the MotiFlex *e*100 is affected by the chosen overload type and switching frequency, as shown in Table 26. These settings can be selected in the Mint WorkBench Drive Setup Wizard - see the Mint help file for details.

	Servo motor		Induction motor		Low speed output (< 2 Hz)	Stationary: DC output (any phase)
	300%, 3 s overload	200%, 3 s overload	150%, 60 s overload	110%, 60 s overload		
4 kHz	17 A	24 A	25 A	25 A	21 A*	31 A (DC)
8 kHz	15 A	21 A	23 A	23 A	20 A*	24 A (DC)
16 kHz	10 A	14 A	14 A	15 A	9 A*	13.8 A (DC)

* Estimated values

Table 26 - Continuous current ratings for 21 A model

The continuous current ratings shown in Table 26 must be derated if the drive is operating in an ambient temperature between 45 °C (113 °F) and the absolute maximum operating temperature of 55 °C (131 °F):

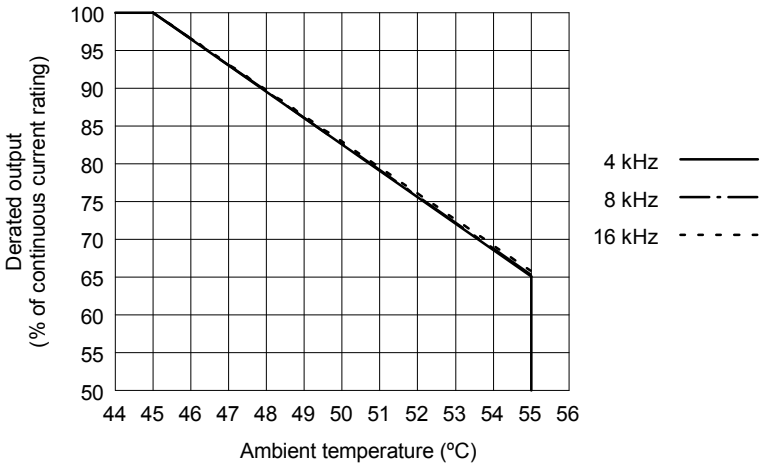


Figure 90 - Temperature derating for 21 A model

CAUTION

When sharing the DC bus, it becomes critical to consider the overall power being derived from the drive's internal power supply. See section 8.2.3.

8.3.11 Motor output rating adjustment - 26 A model

The continuous current rating of the MotiFlex *e*100 is affected by the chosen overload type and switching frequency, as shown in Table 27. These settings can be selected in the Mint WorkBench Drive Setup Wizard - see the Mint help file for details.

	Servo motor		Induction motor		Low speed output (< 2 Hz)	Stationary: DC output (any phase)
	300%, 3 s overload	200%, 3 s overload	150%, 60 s overload	110%, 60 s overload		
4 kHz	20 A	29 A	29 A	29 A	25 A*	42 A (DC)
8 kHz	19 A	26 A	26 A	26 A	22 A*	32 A (DC)
16 kHz	12.5 A	12.5 A	12.5 A	12.5 A	8 A*	14 A (DC)

* Estimated values

Table 27 - Continuous current ratings for 26 A model

The continuous current ratings shown in Table 27 must be derated if the drive is operating in an ambient temperature between 45 °C (113 °F) and the absolute maximum operating temperature of 55 °C (131 °F):

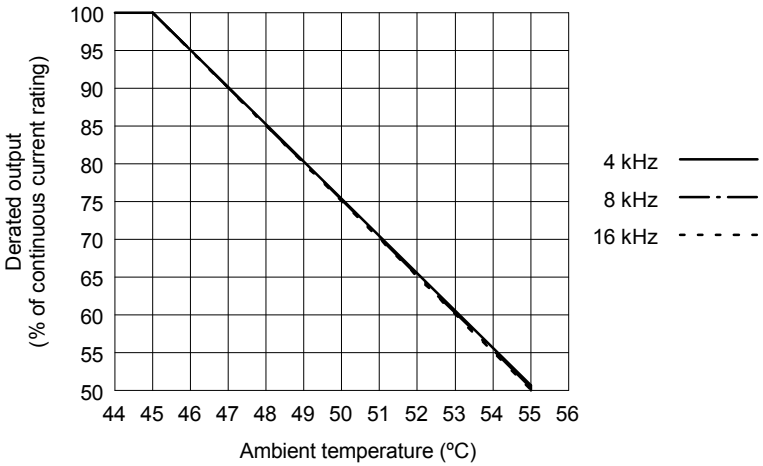


Figure 91 - Temperature derating for 26 A model

CAUTION

When sharing the DC bus, it becomes critical to consider the overall power being derived from the drive's internal power supply. See section 8.2.3.

8.3.12 Motor output rating adjustment - 33.5 A model

The continuous current rating of the MotiFlex *e*100 is affected by the chosen overload type and switching frequency, as shown in Table 28. These settings can be selected in the Mint WorkBench Drive Setup Wizard - see the Mint help file for details.

	Servo motor		Induction motor		Low speed output (< 2 Hz)	Stationary: DC output (any phase)
	300%, 3 s overload	200%, 3 s overload	150%, 60 s overload	110%, 60 s overload		
4 kHz	24.5 A	33.5 A	33.5 A	33.5 A	28 A*	42 A (DC)
8 kHz	19 A	26 A	26 A	26 A	16 A*	32 A (DC)

* Estimated values

Table 28 - Continuous current ratings for 33.5 A model

The continuous current ratings shown in Table 28 must be derated if the drive is operating in an ambient temperature between 45 °C (113 °F) and the absolute maximum operating temperature of 55 °C (131 °F):

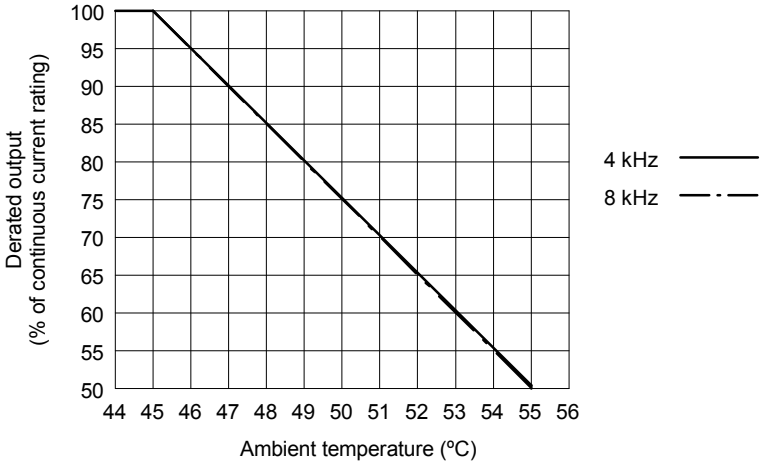


Figure 92 - Temperature derating for 33.5 A model

CAUTION

When sharing the DC bus, it becomes critical to consider the overall power being derived from the drive's internal power supply. See section 8.2.3.

8.3.13 Motor output rating adjustment - 48 A model

The continuous current rating of the MotiFlex *e*100 is affected by the chosen overload type and switching frequency, as shown in Table 28. These settings can be selected in the Mint WorkBench Drive Setup Wizard - see the Mint help file for details.

	Servo motor		Induction motor		Low speed output (< 2 Hz)	Stationary: DC output (any phase)
	300%, 3 s overload	200%, 3 s overload	150%, 60 s overload	110%, 60 s overload		
4 kHz	33 A	48 A	60 A	65 A	48	75
8 kHz	27 A	40 A	47 A	54 A	40	59

* Estimated values

Table 29 - Continuous current ratings for 48 A model

The continuous current ratings shown in Table 28 must be derated if the drive is operating in an ambient temperature between 45 °C (113 °F) and the absolute maximum operating temperature of 55 °C (131 °F):

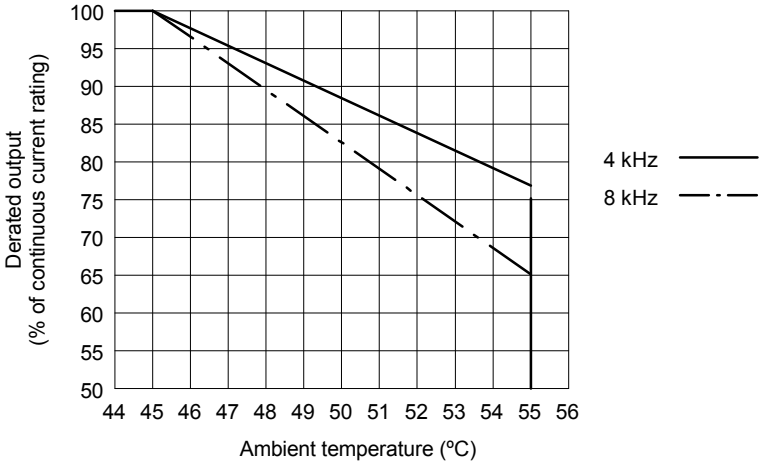


Figure 93 - Temperature derating for 48 A model

CAUTION

When sharing the DC bus, it becomes critical to consider the overall power being derived from the drive's internal power supply. See section 8.2.3.

8.3.14 Motor output rating adjustment - 65 A model

The continuous current rating of the MotiFlex *e*100 is affected by the chosen overload type and switching frequency, as shown in Table 28. These settings can be selected in the Mint WorkBench Drive Setup Wizard - see the Mint help file for details.

	Servo motor		Induction motor		Low speed output (< 2 Hz)	Stationary: DC output (any phase)
	300%, 3 s overload	200%, 3 s overload	150%, 60 s overload	110%, 60 s overload		
4 kHz	43 A	65 A	65 A	65 A	65	75
8 kHz	35 A	48 A	52 A	58 A	48	59

* Estimated values

Table 30 - Continuous current ratings for 65 A model

The continuous current ratings shown in Table 28 must be derated if the drive is operating in an ambient temperature between 45 °C (113 °F) and the absolute maximum operating temperature of 55 °C (131 °F):

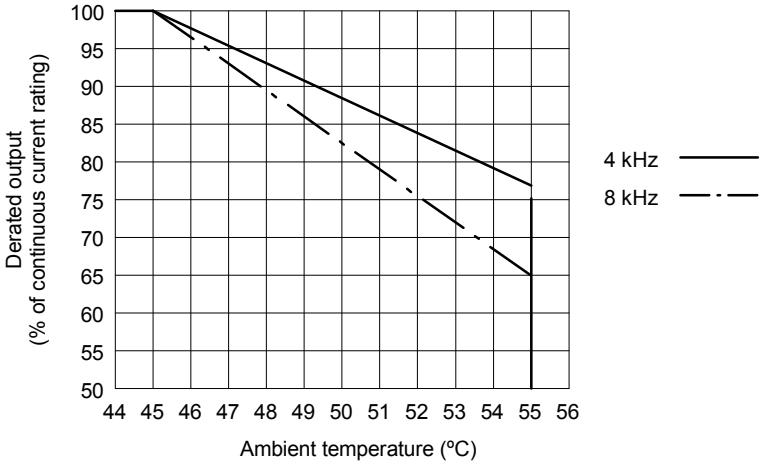


Figure 94 - Temperature derating for 65 A model

CAUTION

When sharing the DC bus, it becomes critical to consider the overall power being derived from the drive's internal power supply. See section 8.2.3.

8.4 Regeneration

8.4.1 Regeneration (X1) - 1.5 A ~ 16 A models

	Unit	1.5 A	3 A	6 A	10.5 A	16 A
Nominal switching threshold (typical)	**VDC**	on: 800, off: 775				
Nominal power (10% power cycle, standalone)	**kW**	1.07 (R = 60 Ω)			1.94 (R = 33 Ω)	
Peak power (10% power cycle, standalone)	**kW**	10.7 (R = 60 Ω)			19.4 (R = 33 Ω)	
Maximum regeneration switching current	**A_{PK}**	13.3			24.2	
Minimum load resistance 'standalone' drive sharing DC bus, or duty >0.2	**Ω**	 60 150			 33 68	
Maximum load inductance	**µH**	100				

8.4.2 Regeneration (X1) - 21 A ~ 33.5 A models

	Unit	21 A	26 A	33.5 A
Nominal switching threshold (typical)	**VDC**	on: 800, off: 775		
Nominal power (10% power cycle, R = 15 Ω)	**kW**	4.27		
Peak power (10% power cycle, R = 15 Ω)	**kW**	42.7		
Maximum regeneration switching current	**A_{PK}**	53.3		
Minimum load resistance 'standalone' drive sharing DC bus, or duty >0.2	**Ω**	 15 60		
Maximum load inductance	**µH**	100		

8.4.3 Regeneration (X1) - 48 A ~ 65 A models

	Unit	48 A	65 A
Nominal switching threshold (typical)	**VDC**	on: 800, off: 775	
Nominal power (10% power cycle, R = 15 Ω)	**kW**	8.53	
Peak power (10% power cycle, R = 15 Ω)	**kW**	85.3	
Maximum regeneration switching current	**A_{PK}**	106	
Minimum load resistance 'standalone' drive sharing DC bus, or duty >0.2	**Ω**	 7.5 33	
Maximum load inductance	**µH**	100	

8.5 18 VDC output / 24 VDC input

8.5.1 18 VDC output / 24 VDC control circuit backup supply input (X2)

When operating as an output:	Unit	All models
Nominal output voltage	**VDC**	15
Minimum output voltage		12
Maximum output voltage		19
Maximum continuous output current	**mA**	50 (limited by PTC)
When operating as in input:		
Nominal input voltage	**VDC**	24
Minimum input voltage		20
Maximum input voltage		30
Maximum ripple	**%**	±10
Maximum continuous input current @24 VDC input: powering encoder @ 250mA, no option cards fitted powering encoder @ 250mA + option card(s)	**A**	 0.8 1.2

8.5.2 Option card power supply

When using more than one option card, the power consumption of the option card combination must be considered, since there is limited power available. The power requirements of the various options are described in the following table:

Option	Power requirement (max)
Resolver	3.8 W
Incremental Encoder	3.9 W
Analog I/O	2.9 W
Digital I/O	0.85 W
Mint	5 W
Fieldbus	Bus dependent: see option's own installation manual.

8.5.2.1 Derating option card power supply when AC supply is not present

The available power to the option cards depends on the ambient temperature and whether the MotiFlex *e*100 is powered from the AC supply or from only the 24 VDC backup supply.

If the AC supply is present, a maximum of 10 W is available to power the option cards, at temperatures up to 55 ºC (131 ºF).

If only the 24 VDC backup supply is present, the total power available to the option cards must be derated as shown in Table 31:

Ambient temperature not exceeding	Backup supply voltage	Maximum available additional current drawn from backup supply for option cards	Maximum power available for option cards
35 ºC (95 ºF)	20 V	0.5 A	10 W
45 ºC (113 ºF)	30 V	0.33 A	10 W
	20 V	0.35 A (0.5 A)*	7 W (10 W)*
55 ºC (131 ºF)	30 V	0.2 A (0.33 A)*	6 W (10 W)*
	20 V	0.2 A (0.5 A)*	4 W (10 W)*

* Figures shown in brackets are for a maximum of 1 hour.

Table 31 - Derating option card power supply when AC supply is not present

8.6 Input / output

8.6.1 Analog input - AIN0 (X3)

	Unit	All models
Type		Differential
Common mode voltage range	**VDC**	±10
Input impedance	**kΩ**	120
Input ADC resolution	**bits**	12 (includes sign bit)
Equivalent resolution (±10 V input)	**mV**	±4.9
Sampling interval	**µs**	250

8.6.2 Digital inputs - drive enable and DIN0 general purpose (X3)

	Unit	All models
Type		Opto-isolated inputs
Input voltage Nominal Minimum Maximum Active Inactive	**VDC**	 24 12 30 > 12 < 2
Input current (maximum, per input)	**mA**	50
Sampling interval	**ms**	1
Minimum pulse width	**µs**	5

8.6.3 Digital inputs DIN1, DIN2 - high speed general purpose (X3)

	Unit	All models
Type		Opto-isolated inputs
Input voltage Nominal Minimum Maximum Active Inactive	**VDC**	 24 12 30 > 12 < 2
Input current (maximum, per input)	**mA**	20
Maximum input frequency	**MHz**	1
Minimum pulse width	**ns**	250

8.6.4 Digital outputs DOUT0, DOUT1 - status and general purpose (X3)

	Unit	All models
User supply (maximum)	**V**	28
Output current (max. continuous)	**mA**	100
Fuse Approximate trip current Reset time	 **mA** **s**	 200 < 20
Update interval	**ms**	1

8.6.5 Incremental encoder interface (X8)

	Unit	All models
Encoder interface		RS422 A/B Differential, Z index
Maximum input frequency (quadrature)	**MHz**	8
Hall inputs		RS422 A/B Differential
Output power supply to encoder		5 VDC (±7%), 200 mA max.
Maximum recommended cable length		30.5 m (100 ft)

8.6.6 SSI interface (X8)

	Unit	All models
SSI encoder interface		Differential Data and Clock
Operating mode (Baldor motors)		Single turn. Positioning resolution up to 262144 counts/rev (18-bit)
Output power supply to encoder		5 VDC (±7%), 200 mA max.
Maximum recommended cable length		30.5 m (100 ft)

8.6.7 BiSS interface (X8)

	Unit	All models
BiSS encoder interface		Differential Data and Clock
Operating mode		Single or multi-turn. A wide range of devices can be supported. Contact Baldor technical support before selecting a device.
Output power supply to encoder		5 VDC (±7%), 200 mA max.
Maximum recommended cable length		30.5 m (100 ft)

8.6.8 SinCos / EnDat interface (X8)

	Unit	All models
Absolute encoder interface		EnDat / SinCos differential inputs and data input
Sin+/- & Cos+/- differential pair input voltage Nominal Minimum Maximum		Centered on a 2.5 V reference: 1 V p-p 0.6 V p-p 1.1 V p-p
Operating modes (Baldor motors)		Single or multi-turn. 512 or 2048 Sin/Cos cycles per turn, with absolute positioning resolution of up to 65536 steps. (Many other encoder specifications are supported - contact Baldor.)
Output power supply to encoder		5 VDC (±7%), 200 mA max.
Maximum recommended cable length		30.5 m (100 ft)

8.6.9 Ethernet interface

Description	Unit	All models
Signal		2 twisted pairs, magnetically isolated
Protocols		Ethernet POWERLINK & TCP/IP
Bit rates	**Mbit/s**	100

8.6.10 CAN interface

Description	Unit	All models
Signal		2-wire, isolated
Channels		1
Protocol		CANopen
Bit rates	**Kbit/s**	10, 20, 50, 100, 125, 250, 500, 1000

8.6.11 RS485 interface (X6)

Description	Unit	Value
Signal		RS485, 2-wire, non-isolated
Bit rates	**Baud**	9600, 19200, 38400, 57600 (default), 115200
Nominal output voltage	**VDC**	8.6
Minimum output voltage		8.1
Maximum output voltage		9
Maximum continuous output current	**mA**	300

8.7 Weights and dimensions

8.7.1 Weights and dimensions - 1.5 A ~ 16 A models

Description	1.5 A	3 A	6 A	10.5 A	16 A
Weight	1.90 kg (4.2 lb)	1.90 kg (4.2 lb)	1.90 kg (4.2 lb)	4.80 kg (10.6 lb)	5.80 kg (12.8 lb)
Nominal overall dimensions (H x W x D, mounted)	362 mm x 76 mm x 260 mm (14.24 in x 2.99 in x 10.24 in)				

8.7.2 Weights and dimensions - 21 A ~ 33.5 A models

Description	21 A	26 A	33.5 A
Weight	5.85 kg (12.9 lb)	6.35 kg (14.0 lb)	6.35 kg (14.0 lb)
Nominal overall dimensions (H x W x D, mounted)	362 mm x 128 mm x 260 mm (14.24 in x 5.04 in x 10.24 in)		

8.7.3 Weights and dimensions - 48 A ~ 65 A models

Description	48 A	65 A
Weight	12.45 kg (27.4 lb)	12.45 kg (27.4 lb)
Nominal overall dimensions (H x W x D, mounted)	362 mm x 213 mm x 260 mm (14.25 in x 8.39 in x 10.24 in)	

8.8 Environmental

All models	Unit	All models	
Operating temperature range*		**°C**	**°F**
Minimum Maximum Derate		+0 +45 See section 8.3.4	+32 +113 See section 8.3.4
Operating humidity range maximum, non-condensing	**%**	93 (ambient temp. < 45 °C / 113 °F) 70 (ambient temp. up to 55 °C / 131 °F)	
Storage temperature range*		-40 to +85	-40 to +185
Storage humidity		Condensation on drive must be avoided. Allow 2 hours acclimatization in installation area before applying power.	
Humidity maximum, non-condensing*	**%**	93	
Maximum installation altitude above m.s.l.	**m** **ft**	1000 Derate 1.1% / 100 m over 1000 m 3300 Derate 1.1% / 330 ft over 3300 ft	
Shock*		10 G	
Vibration*		1 G, 10-150 Hz	
IP rating		IP20**	

* MotiFlex *e*100 complies with the following environmental test standards:

BS EN60068-2-1:1993 low temperature operational 0 °C.
BS EN60068-2-2:1993 high temperature operational 45 °C.
BS EN60068-2-1:1993 low temperature storage/transportation -40 °C.
BS EN60068-2-2:1993 high temperature storage/transportation +85 °C.
BS EN60068-2-27:2009 Test “Ea” (shock)
BS EN60068-2-6:2008 Test “Fc” (vibration)

** MotiFlex *e*100 complies with EN60529, IP2*x*, provided connectors X1 and X17 are shrouded. MotiFlex *e*100 complies with EN60529, IP3*x*, if it is either:

- mounted in a cabinet, or;
- connectors X1 and X17 are shrouded and objects are prevented from entering the ventilation slots.

A.1 Introduction

This section describes accessories and options that you may need to use with your MotiFlex *e*100. Shielded (screened) cables provide EMI / RFI shielding and are required for compliance with CE regulations. All connectors and other components must be compatible with the shielded cable.

A.1.1 Busbars for DC bus sharing

Plated copper busbars are required to allow the DC bus voltage to be shared between neighboring MotiFlex *e*100 drives. The busbars are made from tin plated copper, and are available in four different sizes. The required size depends upon the combination of drive types and their relative positions. See Figure 6 on page 3-9 to determine which busbars are required.

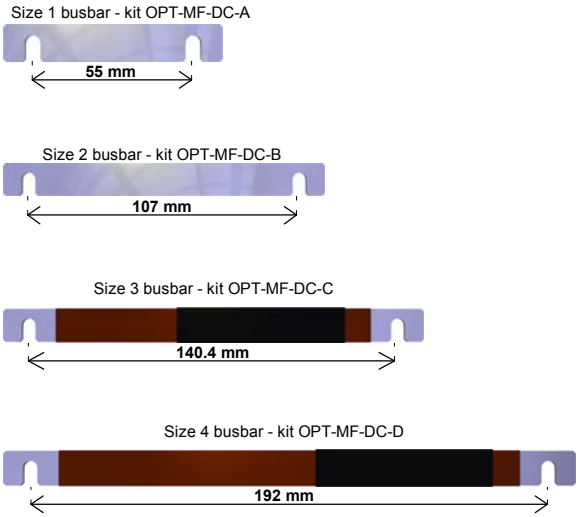

Size 1 busbar - kit OPT-MF-DC-A
55 mm
Size 2 busbar - kit OPT-MF-DC-B
107 mm
Size 3 busbar - kit OPT-MF-DC-C
140.4 mm
Size 4 busbar - kit OPT-MF-DC-D
192 mm

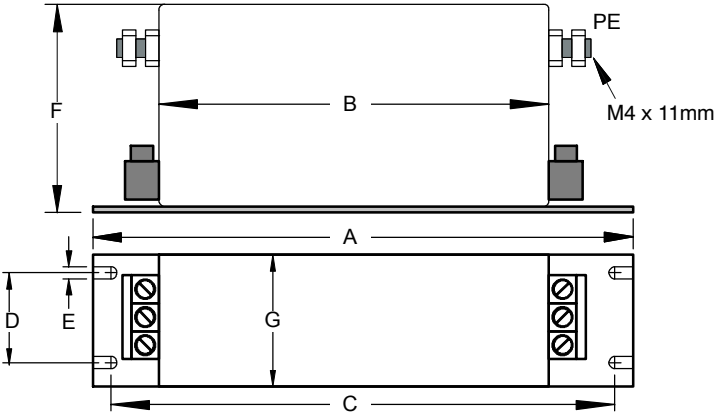
Figure 95 - Using busbars for DC bus sharing

A.1.2 AC supply (EMC) filters

AC filters remove high frequency noise from the AC power supply, protecting the MotiFlex *e*100. These filters also prevent high frequency signals from being transmitted back onto the power lines and help meet EMC requirements. To select the correct filter, see section 3.4.10.

A.1.2.1 Catalog numbers

Baldor catalog number	Rated volts (VAC)	Rated amps @ 40 °C	Weight kg (lbs)
FI0035A00	520	8	0.58 (1.28)
FI0035A01	520	16	0.90 (1.98)
FI0035A02	520	25	1.1 (2.42)
FI0035A03	520	36	1.75 (3.85)
FI0035A04	520	50	1.75 (3.85)
FI0035A05	520	66	2.7 (5.95)



Terminal block connections - tightening torque and maximum wire size:
FI0035A00 / A01 / A02: 0.5 - 0.6 N·m (4.4 - 5.3 lb-in), 4 mm^2.
FI0035A03 / A04 / A05: 1.2 - 1.5 N·m (10.6 - 13.3 lb-in), 10 mm^2.

Dim.	Dimensions *mm (inches)*					
	FI0035A00	FI0035A01	FI0035A02	FI0035A03	FI0035A04	FI0035A05
A	165 (6.49)	231 (9.09)		265 (10.43)		
B	133.7 (5.26)	199.5 (7.85)		200 (7.87)		
C	155 (6.10)	221 (8.70)		255 (10.04)		
D	38 (1.50)	38 (1.50)		35 (1.38)		
E	4.5 (0.18)	4.5 (0.18)		4.5 (0.18)		
F	63 (2.48)	70 (2.76)	83 (3.27)	90 (3.54)		141.5 (5.57)
G	51.4 (2.02)	46.4 (1.83)		58 (2.28)		

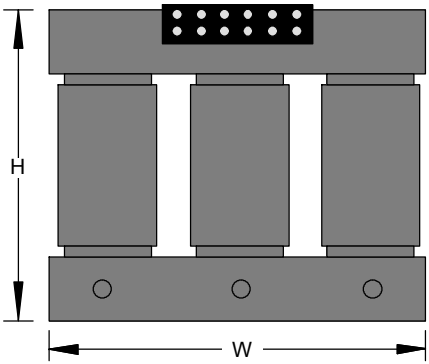
Figure 96 - Filter dimensions, types FI0035A00...A05

A.1.3 AC line reactors

AC line reactors provide bi-directional protection, reducing unwanted electrical noise, harmonics and overvoltage trips. A line reactor should always be used when a MotiFlex *e*100 is sharing its DC bus with other drives (see section 3.5).

A.1.3.1 Catalog numbers

Baldor catalog number	Rated volts (VAC)	Rated power (kW)	Rated current (A)	Impedance (%)	Inductance (mH)	Weight kg (lbs)
LRAC00802	380/400/415	3.7	8	3	3.0	3.6 (8)
LRAC02502	380/400/415	11.1	25	3	1.2	6.4 (14)
LRAC03502	575	14.9	35	3	0.8	7.3 (16)
LRAC05502	575	29.8	55	3	0.5	12.2 (27)
LRAC08002	380/400/415	37.2	80	3	0.4	14.5 (32)



	Dimensions *mm (inches)*				
Dimension	LRAC00802	LRAC02502	LRAC03502	LRAC05502	LRAC08002
H	122 (4.8)	142 (5.6)	145 (5.7)	178 (7)	210 (8.25)
W	152 (6)	183 (7.2)	183 (7.2)	229 (9)	229 (9)
D	79 (3.1)	86 (3.4)	97 (3.8)	122 (4.8)	135 (5.3)

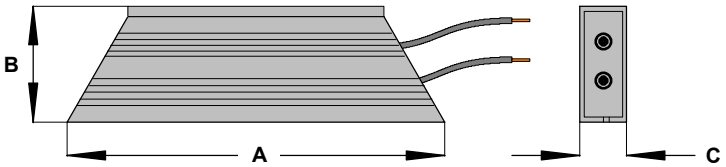
Figure 97 - Line reactor dimensions

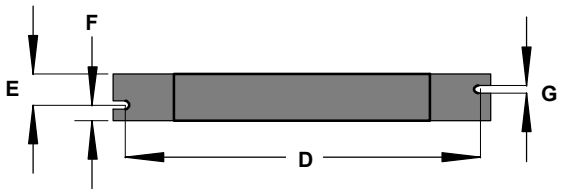
A.1.4 Regeneration resistors

Depending on the application, MotiFlex *e*100 might require an external regeneration resistor to be connected to pins R1 and R2 of connector X1. The regeneration resistor dissipates energy during braking to prevent an over-voltage error occurring. See sections 3.8 and 3.9 for details about choosing the correct resistor. The MotiFlex *e*100 is UL listed when using these resistors.

DANGER

Electrical shock hazard. DC bus voltages may be present at these terminals. Use a suitable heatsink (with fan if necessary) to cool the regeneration resistor. The regeneration resistor and heatsink (if present) can reach temperatures in excess of 80 °C (176 °F). See section 3.9.5 for derating information. The regeneration resistors listed here do not provide a fail-safe safety mechanism. For safety reasons and UL compliance, they will become open-circuit in the event of failure. This will cause the MotiFlex *e*100 to trip due to overvoltage, leaving the motor in an uncontrolled state. Further safety mechanisms such as a motor brake will be required, especially for applications involving suspended or tensioned loads.

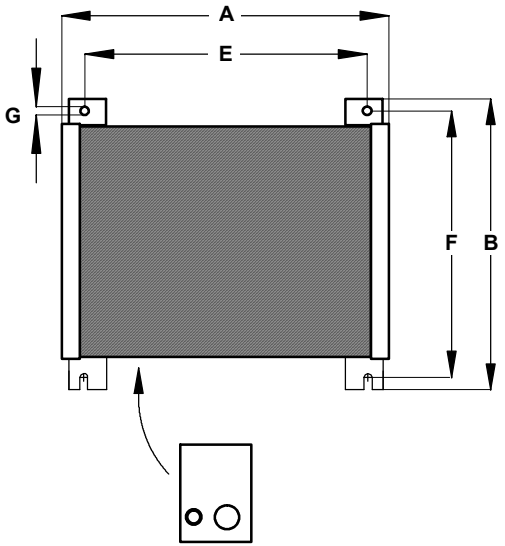


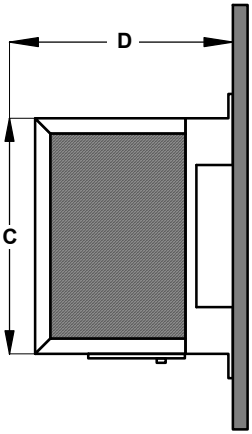


Weights:
RGJ160: 215 g (7.6 oz)
RGJ1150: 215 g (7.6 oz)
RGJ260: 447 g (15.8 oz)
RGJ2150: 447 g (15.8 oz)
RGJ360: 600 g (21.2 oz)
RGJ368: 600 g (21.2 oz)
RGJ3150: 600 g (21.2 oz)
RGJ515: 980 g (34.6 oz)
RGJ523: 980 g (34.6 oz)
RGJ533: 980 g (34.6 oz)

Baldor catalog number	Power *W*	Res. Ω	Dimensions *mm (inches)*						
			A	B	C	D	E	F	G
RGJ160	100	60	165 (*6.49*)	41 (*1.61*)	22 (*0.87*)	152 (*5.98*)	12 (*0.47*)	10 (*0.39*)	4.3 (*0.17*)
RGJ1150		150							
RGJ260	200	60	165 (*6.49*)	60 (*2.36*)	30 (*1.18*)	146 (*5.75*)	17 (*0.67*)	13 (*0.51*)	5.3 (*0.21*)
RGJ2150		150							
RGJ360	300	60	215 (*8.46*)	60 (*2.36*)	30 (*1.18*)	196 (*7.72*)	17 (*0.67*)	13 (*0.51*)	5.3 (*0.21*)
RGJ368		68							
RGJ3150		150							
RGJ515	500	15	335 (*13.19*)	60 (*2.36*)	30 (*1.18*)	316 (*12.44*)	17 (*0.67*)	13 (*0.51*)	5.3 (*0.21*)
RGJ523		23							
RGJ533		33							

Figure 98 - Regeneration resistor dimensions - RGJ models





Weights:
RGA1210: 5.9 kg (13 lb)
RGA2410: 9.1 kg (20 lb)
RGA4810: 11.8 kg (26 lb)

Baldor catalog number	Pwr. *W*	Res. Ω	Dimensions *mm (inches)*						
			A	B	C	D	E	F	G
RGA1210	1200	10	279 (*11.0*)	247.7 (*9.75*)	201.1 (*7.92*)	168.9 (*6.65*)	241.3 (*9.5*)	228.6 (*9.0*)	7 (*0.28*)
RGA2410	2400	10	279 (*11.0*)	400 (*15.75*)	353.6 (*13.92*)	270.5 (*10.65*)	241.3 (*9.5*)	381 (*15.0*)	7 (*0.28*)
RGA4210	4800	10							

Figure 99 - Regeneration resistor dimensions - RGA models

A.1.5 Motor / power cable management bracket

The motor / power cable management bracket, part OPT-CM-001, provides a simple means of clamping the outer screen of the motor's power cable or AC supply cable. The bracket is supplied with clamps suitable for typical motor power cables. The bracket can be mounted just below the MotiFlex *e*100, as shown in Figure 100:

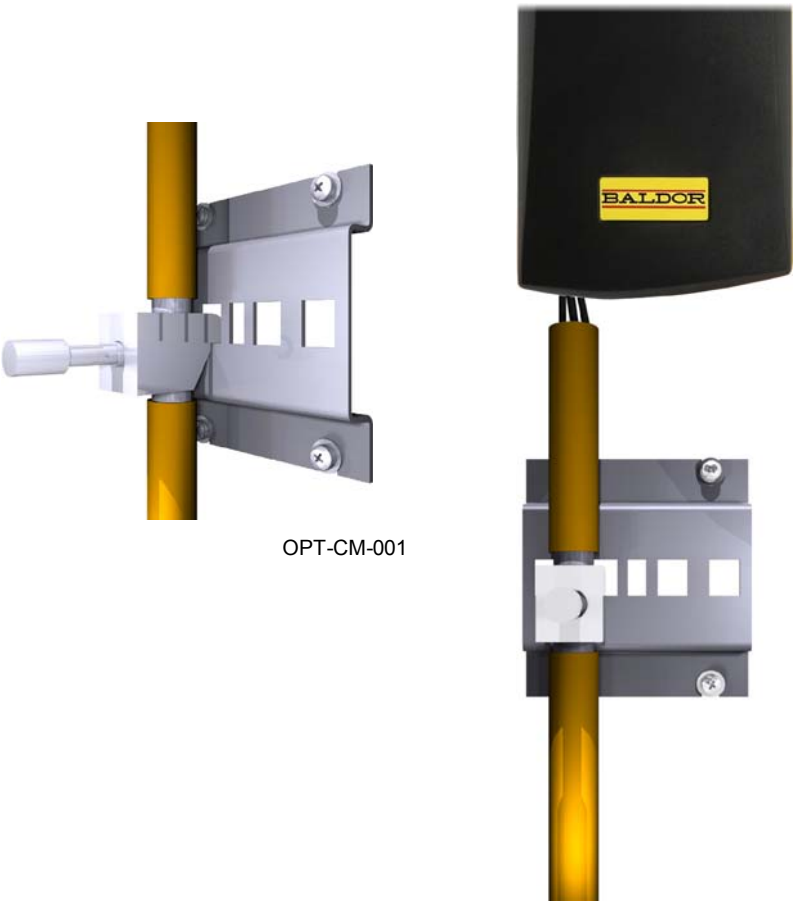


Figure 100 - Motor cable management bracket

A.1.6 Signal cable management bracket

The signal cable management bracket, part OPT-CM-002 (for 1.5 A ~ 16 A models) and part OPT-CM-003 (for 21 A ~ 65 A models), provides a simple means of clamping the outer screen of the motor's feedback cable or other shielded signal cables. The bracket is supplied with clamps suitable for typical motor feedback cables. By using additional clamps, the bracket can hold other signals cables too. The bracket must be attached to the metal tab that protrudes from the bottom of the MotiFlex *e*100, as shown in Figure 101:

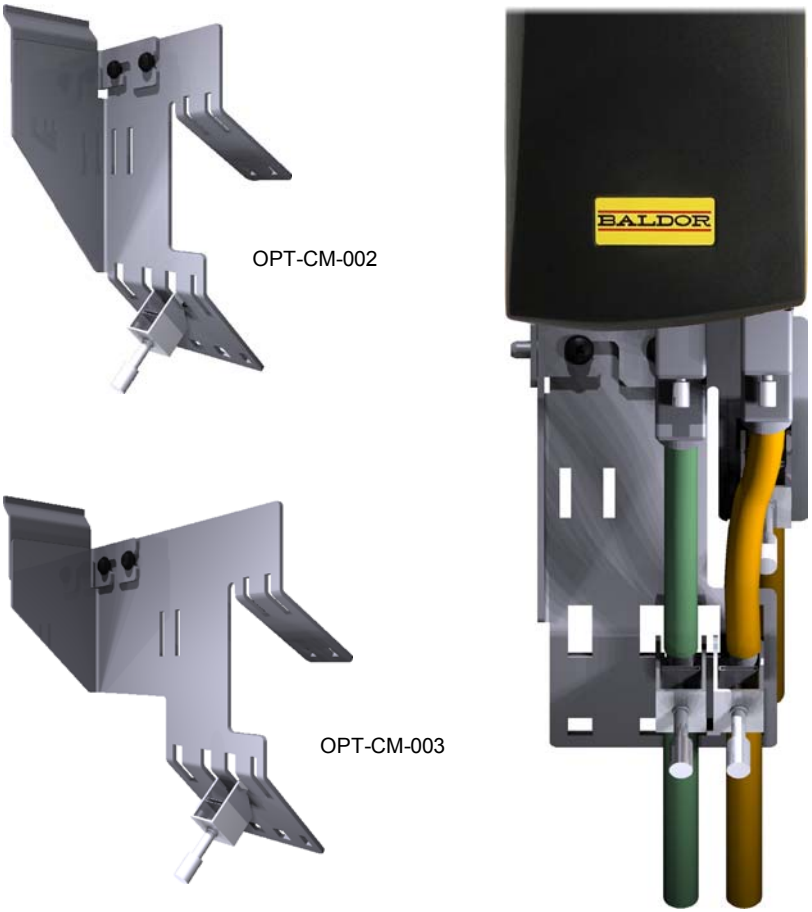


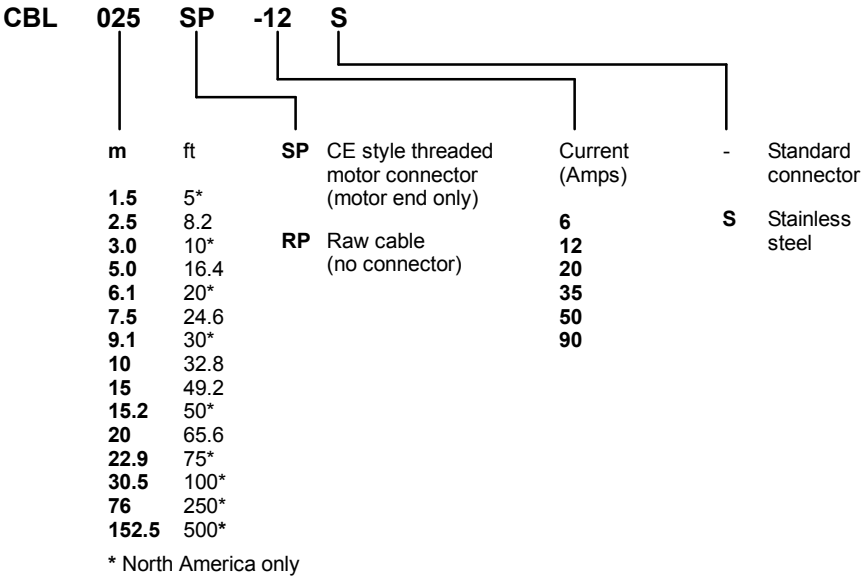
Figure 101 - Signal cable management brackets

A.2 Cables

A wide range of motor and feedback cables are available from Baldor.

A.2.1 Motor power cables

For easier installation, it is recommended that a color-coded motor power cable is used. The Baldor part number for a BSM rotary motor power cable is derived as follows:



* North America only

Larger motors requiring 35 A cable or greater normally use terminal box connections, so a motor power connector is not required. For this reason connectors are not available on 35 A - 90 A cable.

Examples:

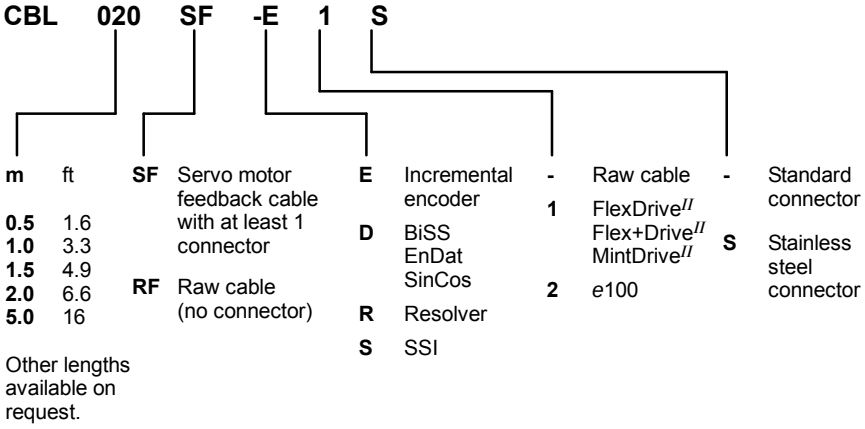
A 6.1 m cable, with a CE threaded standard connector, rated for 12 A has part number **CBL061SP-12**.

A 30.5 m cable, with a CE threaded stainless steel connector, rated for 20 A has part number **CBL305SP-20S**.

A 50 ft cable, with no connector, rated for 50 A has part number **CBL152RP-50**.

A.2.2 Feedback cable part numbers

The Baldor part number for a feedback cable is derived as follows:



Examples:

A 2 m encoder feedback cable for a MicroFlex *e*100 drive, with required connectors at both ends, has part number **CBL020SF-E2**.

A 1 m EnDat cable for a MintDrive *II*, with drive connector and stainless steel motor connector, has part number **CBL010SF-D1S**.

Baldor feedback cables have the outer shield tied to the connector housing(s). If you are not using a Baldor cable with your chosen feedback device, be sure to obtain a cable that is a shielded twisted pair 0.34 mm^2 (22 AWG) wire minimum, with an overall shield. Ideally, the cable should not exceed 30.5 m (100 ft) in length. Maximum wire-to-wire or wire-to-shield capacitance is 50 pF per 300 mm (1 ft) length, to a maximum of 5000 pF for 30.5 m (100 ft).

A.2.3 Ethernet cables

The cables listed in this table connect MotiFlex *e*100 to other EPL nodes such as NextMove *e*100, additional MotiFlex *e*100s, or other EPL compatible hardware. The cables are standard CAT5e shielded twisted pair (S/UTP) 'crossover' Ethernet cables:

Cable assembly description	Baldor catalog number	Length	
		m	ft
CAT5e Ethernet cable	CBL002CM-EXS	0.2	0.65
	CBL005CM-EXS	0.5	1.6
	CBL010CM-EXS	1.0	3.3
	CBL020CM-EXS	2.0	6.6
	CBL050CM-EXS	5.0	16.4
	CBL100CM-EXS	10.0	32.8

B.1 Introduction

The MotiFlex *e*100 can use two main control configurations:

- Servo (Position).
- Torque Servo (Current).

Each configuration supports different control modes, selected by using the Tools, Control Mode menu item or by using the CONTROLMODE keyword in the Command window (see the Mint help file). The control configurations are described in the following sections.

B.1.1 Servo configuration

The servo configuration is the default configuration for the drive, allowing the motor control system to operate as a torque controller, a velocity controller or a position controller. This configuration comprises 3 nested control loops; a current control loop, a velocity control loop and a position control loop, as shown in Figure 102.

The universal encoder interface reads rotor position from the encoder and estimates velocity. The commutation block uses the position to calculate the electrical angle of the rotor. The current sensor system measures U and V phase currents. These are fed into a current conversion block that converts them into quantities representing torque producing and magnetizing currents (the 'vector' currents which are locked to the rotor).

In the current control loop, a current demand and the final measured current values form the inputs to a PI (Proportional, Integral) control system. This control system generates a set of voltage demands that are fed into a PWM (pulse-width modulation) block. The PWM block uses the space-vector modulation method to convert these voltage demands into a sequence of U, V and W phase switching signals, which are applied to the output bridge of the drive. The PWM block uses the measured DC bus voltage to compensate for variations in supply voltage.

The torque controller converts a torque demand into a current demand and compensates for various load non-linearities. A 2-stage notch or low-pass filter allows the effects of load compliance to be reduced. To avoid motor damage, a user-defined application current limit is also applied, as well as individual positive and negative torque limits.

In the velocity control loop, a velocity demand and measured velocity form the inputs to a PI control system. The output of the control system is a torque demand which, when the drive is operating as a velocity controller, forms the input to the current control loop.

Finally, in the position control loop, a position demand and measured position form the inputs to a PID (Proportional, Integral, Differential) control system incorporating velocity feedback, velocity feed-forward and acceleration feed-forward. The output of the position control system is a velocity demand which, when the drive is operating as a position controller, forms the input to the velocity control loop.

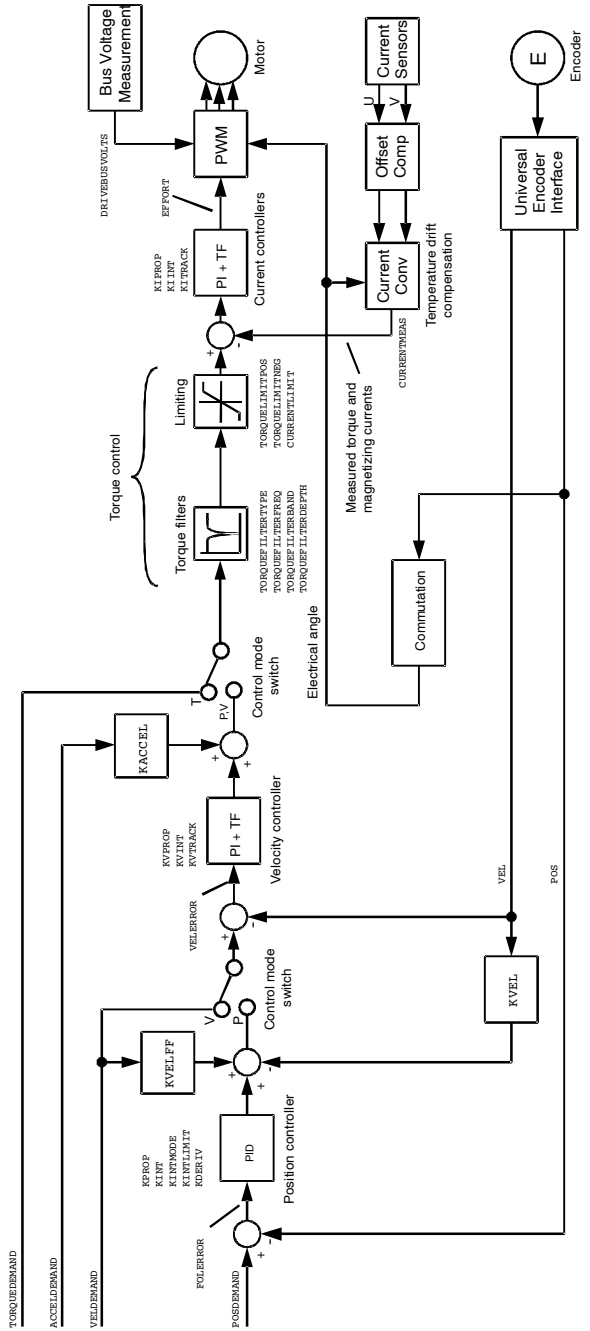


Figure 102 - Servo configuration control structure

B.1.2 Torque servo configuration

Figure 103 shows the torque-servo control configuration. Here, the velocity loop has been removed and the output of the position controller is fed into the current loop via the torque filters.

The torque servo configuration is useful when the drive is operating as a closed-loop position controller and settling time must be minimized. Although the servo configuration tends to give better velocity tracking when operating in position mode, settling times can be longer.

The control mode switch allows the drive to operate in either torque or position modes, but not velocity mode.

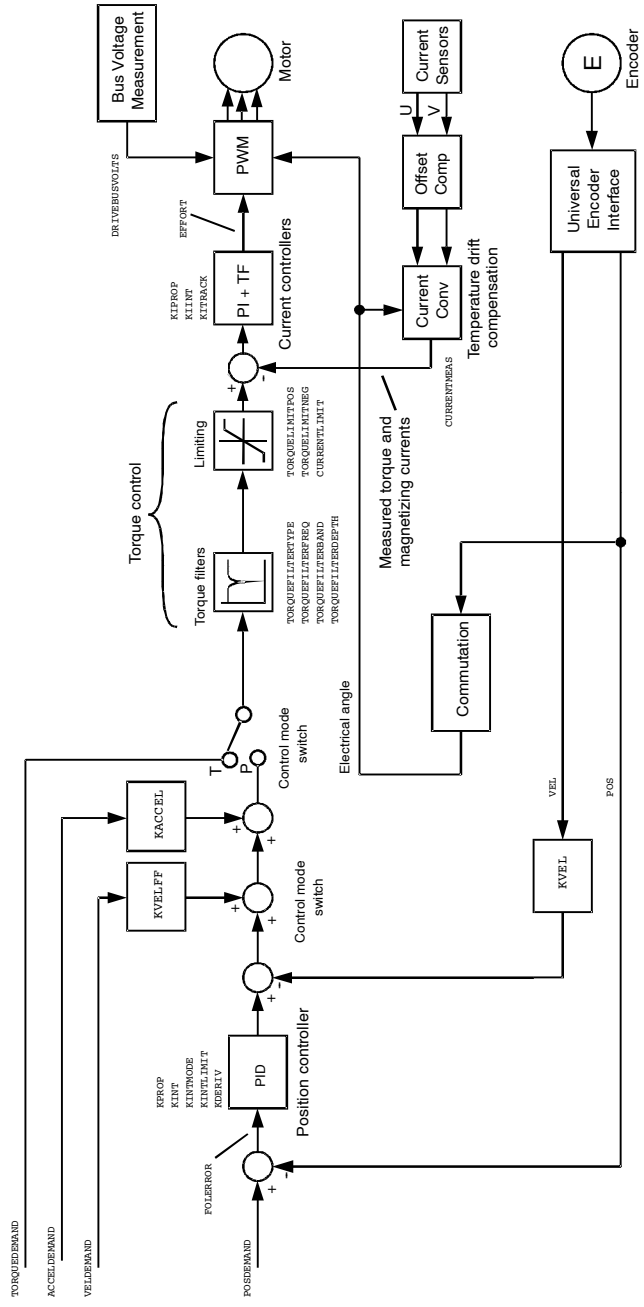


Figure 103 - Torque Servo configuration control structure

C.1 Introduction

The following table summarizes the Mint keywords supported by the MotiFlex *e*100. Note that due to continuous developments of the MotiFlex *e*100 and the Mint language, this list is subject to change. Check the latest Mint help file for full details of new or changed keywords.

C.1.1 Keyword listing

Keyword	Description
ABORT	To abort motion on all axes.
ABORTMODE	To control the default action taken in the event of an abort.
ABSENCODER	To read the current EnDat encoder position.
ABSENCODERTURNS	To set or read the number of turns of unique information available on an absolute encoder.
ACCEL	To define the acceleration rate of an axis.
ACCELDEMAND	To read the instantaneous demand acceleration.
ACCELJERK	To define the jerk rate to be used during periods of acceleration.
ACCELJERKTIME	To define the jerk rate to be used during periods of acceleration.
ACCELSCALEFACTOR	To scale axis encoder counts, or steps, into user defined acceleration units.
ACCELSCALEUNITS	To define a text description for the acceleration scale factor.
ACCELTIME	To define the acceleration rate of an axis.
ACCELTIMEMAX	To define the acceleration rate of an axis.
AXISMODE	To return the current mode of motion.
ADC	To read an analog input value.
ADCDEADBAND	To set the deadband to be applied to an ADC input.
ADCDEADBANDHYSTERESIS	To set a hysteresis level for entering and leaving the deadband on the ADC inputs.
ADCDEADBANDOFFSET	To set the deadband offset to be applied to an ADC input.

Keyword	Description
ADCGAIN	To set the gain to be applied to an ADC input.
ADCOFFSET	To set the offset to be applied to an ADC input.
ADCOFFSETTRIM	To zero (trim) the specified analog input.
ADCTIMECONSTANT	To set the time constant of the low pass filter applied to an ADC input.
AXISPOSENCODER	To select the source of the position signal used in dual encoder feedback systems.
AXISVELENCODER	To select the source of the velocity signal used in dual encoder feedback systems.
BUSBAUD	To specify the bus baud rate.
BUSENABLE	To enable or disable the operation of a fieldbus.
BUSEVENT	Returns the next event in the bus event queue of a specific bus.
BUSEVENTINFO	Returns the additional information associated with a bus event.
BUSNODE	To set or read the node ID used by this node for the specified bus.
BUSPROTOCOL	To read the protocol currently supported on a particular fieldbus.
BUSRESET	Resets the bus controller.
BUSSTATE	Returns the status of the bus controller.
CANCEL	To stop motion and clear errors on an axis.
CANCELALL	To stop motion and clear errors on all axes.
CAPTUREBUFFERSIZE	To read the total size of the capture buffer.
CAPTURECOMMAND	Controls the operation of capture.
CAPTUREDURATION	To define the total duration of the data capture.
CAPTUREEVENT	Configures capturing to stop on an event.
CAPTUREMODE	To set or read the mode on a capture channel.
CAPTUREMODEPARAMETER	To specify a parameter associated with CAPTUREMODE.
CAPTURENUMPOINTS	To read the number of captured points per channel.
CAPTUREPERIOD	To define the interval between data captures.
CAPTUREPRETRIGGER-DURATION	To set the duration of the pre-trigger phase.

Keyword	Description
CAPTUREPROGRESS	To return the progress of the pre-trigger or post-trigger capture phase.
CAPTURESTATUS	To return the progress of the capture.
CAPTURETRIGGER	To generate a capture trigger.
CAPTURETRIGGERABSOLUTE	To ignore the sign of the trigger value when triggering from a capture channel source.
CAPTURETRIGGERCHANNEL	To set the channel to be used as the reference source for triggering.
CAPTURETRIGGERMODE	To set the method used to evaluate the trigger source.
CAPTURETRIGGERSOURCE	To set the reference source to be used for triggering.
CAPTURETRIGGERVALUE	To set the trigger value when triggering from a capture channel source.
COMMSINTEGER	Accesses the reserved comms array, storing values as integers.
COMPAREENABLE	To enable/disable the position compare control of a specific digital output.
COMPAREOUTPUT	To specify the digital output used for position compare.
COMPAREPOS	To write to the position compare registers.
CONFIG	To set the configuration of an axis for different control types.
CONNECT	To enable a connection between two remote nodes to be made or broken.
CONNECTSTATUS	Returns the status of the connection between this node and another node.
CONTROLMODE	To set or read the control mode.
CONTROLMODESTARTUP	To set or read the control mode used when the drive is turned on.
CONTROLRATE	To set the control loop and profiler sampling rates.
CONTROLREFCHANNEL	To specify a channel for the source of the control reference command.
CONTROLREFSOURCE	To specify the source of the control reference command.
CONTROLREFSOURCESTARTUP	To set or read the source of the control reference command used when the drive is turned on.
CURRENTDEMAND	To read the demands to the current controllers.

Keyword	Description
CURRENTLIMIT	To restrict the current output to a defined range.
CURRENTMEAS	Reads the measured current.
CURRENTSENSORMODE	To enable a current sensor temperature drift compensation scheme.
DECEL	To set the deceleration rate on the axis.
DECELJERK	To define the jerk rate to be used during periods of deceleration.
DECELJERKTIME	To define the jerk rate to be used during periods of deceleration.
DECELTIME	To set the deceleration rate on the axis.
DECELTIMEMAX	To define the deceleration rate of an axis.
DRIVEBUSNOMINALVOLTS	To return the nominal value of the DC bus voltage for the drive.
DRIVEBUSOVERVOLTS	To set or return the overvoltage trip level for the drive.
DRIVEBUSUNDERVOLTS	To set or return the undervoltage trip level for the drive.
DRIVEBUSVOLTS	To return the current level of the DC bus.
DRIVEENABLE	To enable or disable the drive for the specified axis.
DRIVEENABLEINPUTMODE	To control the action taken in the event of the drive being disabled from the drive enable input.
DRIVEENABLEOUTPUT	To specify an output as a drive enable.
DRIVEENABLESWITCH	To read the state of the drive enable input.
DRIVEID	To define a text description for the drive.
DRIVEOVERLOADAREA	Reads the extent of a drive overload condition.
DRIVEOVERLOADMODE	Sets or reads the action taken in the event of a drive overload condition.
DRIVEPEAKCURRENT	Reads the peak current rating of the drive.
DRIVEPEAKDURATION	Reads the duration for which peak drive current can be sustained.
DRIVERATEDCURRENT	Reads the continuous current rating for the drive.
DRIVESPEEDFATAL	To define the overspeed trip level.
DRIVESPEEDMAX	To set or read the maximum motor speed to be used.
EFFORT	To read the instantaneous effort applied by the current controllers.

Keyword	Description
ENCODER	To set or read the axis encoder value.
ENCODERCYCLESIZE	To set or read the size of a sin/cos cycle on an encoder.
ENCODERMODE	To make miscellaneous changes to the encoders.
ENCODEROFFSET	To set or read the offset used to calculate encoder position for absolute encoders.
ENCODEROUTCHANNEL	To set or read the encoder channel to be output on a simulated encoder output.
ENCODEROUTRESOLUTION	To set or read the resolution of a simulated encoder output.
ENCODERPRESCALE	To scale down the encoder input.
ENCODERRESOLUTION	To set or read the number of encoder lines (pre-quadrature) for the motor.
ENCODERSCALE	To set or read the scale factor for the encoder channel.
ENCODERTYPE	To set or read the feedback type of the motor.
ENCODERVEL	To read the velocity from an encoder channel.
ENCODERWRAP	To set or read the encoder wrap range for the encoder channel.
ENCODERZLATCH	To get and reset the state of an axis' encoder Z latch.
ERRCODE	To return the last error code read from the error list.
ERRDATA	To return data associated with the last error read from the error list.
ERRLINE	To return the line number of the last error read from the error list.
ERRORCLEAR	To clear all errors in the specified group.
ERRORCODEENABLE	To allow or prevent specific errors to be created.
ERRORDECEL	To set the deceleration rate on the axis for powered stops, in the event of an error or stop input.
ERRORINPUT	To set or return the digital input to be used as the error input for the specified axis.
ERRORINPUTMODE	To control the default action taken in the event of an external error input.
ERRORPRESENT	To determine if errors in a particular group are present in the error list.

Keyword	Description
ERRORREADCODE	To determine if a particular error is present in the error list.
ERRORREADNEXT	Returns the next entry in the specified group from the error list.
ERRORSWITCH	To return the state of the error input.
ERRSTRING	To return the error string for the last error code read from the error list.
ERRTIME	To return the time stamp for the last error code read from the error list.
EVENTACTIVE	To indicate whether an event is currently active.
EVENTDISABLE	To selectively enable and disable Mint events.
EVENTPEND	To manually cause an event to occur.
EVENTPENDING	To indicate whether an event is currently pending.
FACTORYDEFAULTS	To reset parameter table entries to their default values.
FIRMWARERELEASE	To read the release number of the firmware.
FOLERROR	To return the instantaneous following error value.
FOLERRORFATAL	To set the maximum permissible following error before an error is generated.
FOLERRORMODE	To determine the action taken on the axis in the event of a following error.
FOLLOW	To enable encoder following with a specified gear ratio.
FOLLOWMODE	To define the mode of operation of the FOLLOW keyword.
FOLLOWNUMERATOR	To set or read the follow ratio's numerator.
GLOBALERROROUTPUT	Allows the user to specify a global error output which will be deactivated in the event of an error.
GO	To begin synchronized motion.
HALL	To read the current Hall state on feedback devices which use Hall sensors.
HALLFORWARDANGLE	To define the electrical angles at which Hall states change, when the motor is running in the forward direction, for feedback devices which use Hall sensors.
HALLREVERSEANGLE	To define the electrical angles at which Hall states change, when the motor is running in the reverse direction, for feedback devices which use Hall sensors.
HALLTABLE	To define the Hall table for an encoder motor.

Keyword	Description
HOME	To find the home position on an axis.
HOMEACCEL	To set the acceleration rate for the homing profile.
HOMEBACKOFF	To set the home back-off speed factor.
HOMECREEPSPEED	To set the creep speed for homing moves.
HOMEDECEL	To set the deceleration rate for the homing profile.
HOMEINPUT	To set a digital input to be the home switch input for the specified axis. See section 5.3.2.1 or 5.3.3.1 for important details about using a digital input as a home input.
HOMEPHASE	To find the phase of the homing sequence currently in progress.
HOMEPOS	To read the axis position at the completion of the homing sequence.
HOMEREFPOS	To define a reference position for homing moves.
HOMESPEED	To set the speed for the initial seek phase of the homing sequence.
HOMESTATUS	To set or read the status of a homing sequence.
HOMESWITCH	To return the state of the home input.
HOMETYPE	To set the homing mode to be performed at start-up.
IDLE	Indicates if a move has finished executing and the axis has finished moving.
IDLEMODE	To control the checks performed when determining if an axis idle.
IDLEPOS	Reads or sets the idle following error limit.
IDLESETTLINGTIME	To read the time taken for an axis to become idle.
IDLETIME	To specify the period for which the axis must meet its idle conditions before becoming idle.
IDLEVEL	Reads or sets the idle velocity limit.
IN	To read the state of all the inputs on an input bank.
INCA	To set up an incremental move to an absolute position.
INCR	To set up an incremental move to a relative position.
INPUTACTIVELEVEL	To set the active level on the digital inputs.

Keyword	Description
INPUTMODE	To set or return the sum of a bit pattern describing which of the user digital inputs should be edge or level triggered.
INPUTNEGTRIGGER	To set or return the user inputs that become active on negative edges.
INPUTPOSTRIGGER	To set or return the user inputs that become active on positive edges.
INSTATE	To read the state of all digital inputs.
INSTATEX	To read the state of an individual digital input.
INX	To read the state of an individual digital input.
JOG	To set an axis for speed control.
KACCEL	To set the servo loop acceleration feed forward gain.
KDERIV	To set the servo loop derivative gain on the servo axes.
KFINT	To set or read the integral gain of the flux controller for induction motor control.
KFPROP	To set or read the proportional gain of the flux controller for induction motor control.
KIINT	To set the integral gain used by the current controller.
KINT	To set the servo loop integral gain.
KINTLIMIT	To restrict the overall effect of the integral gain KINT.
KINTMODE	To control when integral action will be applied in the servo loop.
KIPROP	To set the proportional gain used by the current controller.
KITRACK	To set the tracking factor used by the current controller.
KPROP	To set the proportional gain for the position controller.
KVEL	To set the servo loop velocity feedback gain term.
KVELFF	To set the velocity feedforward term for the position controller.
KVINT	To set the integral gain used by the speed controller.
KVPROP	To set the proportional gain used by the speed controller.
KVTIME	To set the time constant of a low pass filter, applied to measured speed.

Keyword	Description
KVTRACK	To set the tracking factor used by the speed controller.
LATCH	To read the state of a fast latch channel.
LATCHENABLE	Manually re-enables a fast latch channel.
LATCHINHIBITTIME	To specify a period during which further fast triggers will be ignored.
LATCHINHIBITVALUE	To specify a range of values within which further fast triggers will be ignored.
LATCHMODE	To set the default action to be taken to clear a fast latch.
LATCHSOURCE	To define the source of data to be latched by a fast latch channel.
LATCHSOURCECHANNEL	To define the channel of the source of data to be latched by a fast latch channel.
LATCHTRIGGERCHANNEL	To select which of the fast latch inputs (or outputs) will trigger a fast latch channel.
LATCHTRIGGEREDGE	To define which edge polarity should cause the fast latch to be triggered.
LATCHTRIGGERMODE	To select whether a fast latch is triggered by a digital input or a digital output.
LATCHVALUE	To return the instantaneous latch value that was recorded by a fast latch.
LIFETIME	Returns a lifetime counter for the drive.
LIMIT	To return the state of the forward and reverse limit switch inputs for the given axis.
LIMITFORWARD	To return the state of the forward limit switch input for the given axis.
LIMITFORWARDINPUT	To set the user digital input configured to be the forward end of travel limit switch input for the specified axis.
LIMITMODE	To control the default action taken in the event of a forward or reverse hardware limit switch input becoming active.
LIMITREVERSE	To return the state of the reverse limit switch input for the given axis.
LIMITREVERSEINPUT	To set the user digital input configured to be the reverse end of travel limit switch input for the specified axis.
LOADDAMPING	To define the equivalent viscous damping coefficient for the motor and load.

Keyword	Description
LOADINERTIA	To define the combined inertia of the motor and load.
MASTERCHANNEL	To set or read the channel of the input device used for gearing.
MASTERSOURCE	To set or read the source of the input device used for gearing.
MOTORBRAKEDELAY	To specify engage/disengage delays associated with motor brake control.
MOTORBRAKEMODE	To activate or deactivate motor brake control.
MOTORBRAKEOUTPUT	To specify an output to be used as a control signal for a braked motor.
MOTORBRAKESTATUS	To determine the state of the motor brake control.
MOTORCATALOGNUMBER	To return the catalog number of the motor.
MOTORDIRECTION	To set or read the electrical direction of the motor.
MOTORFEEDBACKANGLE	Reads the instantaneous value of commutation angle for the motor.
MOTORFEEDBACKOFFSET	To set or read the electrical angle at which the absolute position read from an EnDat, BiSS or SSI encoder is zero.
MOTORFLUX	To set the motor's magnetic flux level, to allow the drive to accurately calculate motor torque and compensate for back-EMF.
MOTORLINEARPOLEPITCH	To set or read the distance between north poles on a linear motor.
MOTORLS	To set or read the motor leakage inductance.
MOTORMAGCURRENT	To set or read the magnetizing current (I_m) of an induction motor.
MOTORMAGIND	To set or read the magnetizing inductance (L_m) of an induction motor.
MOTOROVERLOADAREA	Reads the extent of an overload condition.
MOTOROVERLOADMODE	To set or read the action taken in the event of a motor overload condition.
MOTORPEAKCURRENT	To set or read the peak current rating of the motor.
MOTORPEAKDURATION	To set or read the duration for which peak motor current can be sustained.
MOTORPOLES	To set or read the number of motor poles.

Keyword	Description
MOTORRATEDCURRENT	To set or read the rated current of the motor.
MOTORRATEDFREQ	To set or read the rated frequency of an induction motor.
MOTORRATEDSPEEDRPM	To set or read the rated speed of an induction motor.
MOTORRATEDVOLTS	To set or read the rated voltage of an induction motor.
MOTORROTORLEAKAGEIND	To set or read the rotor leakage inductance of an induction motor.
MOTORROTORRES	To set or read the rotor resistance of an induction motor.
MOTORRS	To set the motor stator resistance.
MOTORSLIP	To read the slip of an induction motor.
MOTORSPECNUMBER	To return the spec number of the motor.
MOTORSTATORLEAKAGEIND	To set or read the stator leakage inductance of an induction motor.
MOTORSTATORRES	To set or read the stator resistance of an induction motor.
MOTORTEMPERATUREMODE	To set or read the action taken in the event of the motor overtemperature trip input becoming active
MOTORTEMPERATURESWITCH	To read the state of the motor overtemperature trip input.
MOTORTYPE	To read or set the type of motor.
MOVEA	To set up a positional move to an absolute position.
MOVEBUFFERFREE	To return the number of free spaces in the move buffer for the specified axis.
MOVEBUFFERSIZE	To set or return the size of the move buffer allocated on the specified axis.
MOVER	To set up a positional move to a relative position.
NODELIVE	To determine if a CAN node on the bus is currently live or dead.
NODESCAN	To scan a specific CAN bus for the presence of a specific node.
NODETYPE	To add or remove a CAN node to/from the CAN network. Can also be read to determine the node type.
NUMBEROF	To return information about the abilities of the controller.
OUT	To set or read the state of all the outputs on an output bank.
OUTPUTACTIVELEVEL	To set the active level on the digital outputs.

Keyword	Description
OUTX	To set or read an individual digital output.
PHASESEARCHBACKOFF	To select the back-off distance used to clear an end stop during the phase search sequence.
PHASESEARCHBANDWIDTH	To define the bandwidth used to design the 'debounce' controller used during the initial alignment stage of the phase search sequence.
PHASESEARCHCURRENT	To select amount of current applied to the motor during the phase search sequence.
PHASESEARCHINPUT	To set or read the digital input to be used as the phase search trigger input.
PHASESEARCHMODE	To turn on the 'debounce' controller used during the initial alignment stage of the phase search sequence.
PHASESEARCHOUTPUT	To assign a digital output as the phase search output.
PHASESEARCHSPEED	To select the speed of travel during the search sections of a phase search sequence.
PHASESEARCHSTATUS	To determine whether commutation is aligned on an axis.
PHASESEARCHSWITCH	To return the current state of the phase search input for the axis.
PHASESEARCHTRAVEL	To select the amount of travel during the search sections of a phase search sequence.
PLATFORM	To return the platform type.
POS	To set or read the current axis position.
POSDEMAND	To set or read the instantaneous position demand.
POSOFFSET	To set or read the offset used to calculate axis position for absolute encoders.
POSREMAINING	To indicate the remaining move distance.
POSSCALEFACTOR	To scale axis encoder counts, or steps, into user defined position units.
POSSCALEUNITS	To define a text description for the position scale factor.
POSTARGET	Reads the target position of the current positional move.
POSTARGETLAST	Reads the target position of the last move in the move buffer.
POWERREADYINPUT	To set or read the input used to inform a DC bus receiving drive that mains power has been applied to the source drive.

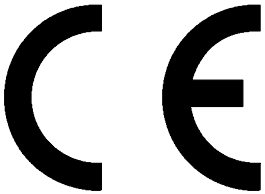
Keyword	Description
POWERREADYOUTPUT	To set or read the output used by a DC bus source drive to inform a DC bus receiving drive that mains power has been applied to the source drive.
PROFILEMODE	To select the type of velocity profiler to use.
REMOTEADC	To read the value of a remote analog input (ADC).
REMOTEADCDELTA	To control the rate of change on a remote analog input before a REMOTEADC message is sent.
REMOTECOMMS	Accesses the reserved comms array on another controller.
REMOTECOMMSINTEGER	Accesses the reserved comms array on another controller, storing values as integers.
REMOTEDAC	To control the value of a remote analog output channel (DAC). The value is a percentage (positive and negative) of the full-scale output value.
REMOTEEMERGENCYMESSAGE	Returns the error code from the last emergency message received from a particular CANopen node.
REMOTEENCODER	To read the value of a remote encoder channel.
REMOTEERROR	Reads the CANopen error register information reported within the last emergency message received from a specific node.
REMOTEIN	To read the state of all the digital inputs on a remote CAN node.
REMOTEINBANK	To read the state of a bank of digital inputs on a remote CAN node.
REMOTEINHIBITTIME	To set or read the CANopen PDO inhibit time.
REMOTEINX	To read the state of individual digital inputs from a remote CAN node.
REMOTEMODE	To control the update mode for a remote node.
REMOTEOBJECT	To access the Object Dictionary of any CANopen node present on the network.
REMOTEOBJECTFLOAT	To access ‘floating-point’ entries in the Object Dictionary of a remote node present on the network.
REMOTEOBJECTSTRING	To access ’Vis-String’ entries in the Object Dictionary of any CANopen node present on the network.
REMOTEOUT	To control the state of digital outputs on a remote CAN node.

Keyword	Description
REMOTEOUTBANK	To read the state of a bank of digital outputs on a remote CAN node.
REMOTEOUTX	To control the state of individual digital outputs on a remote CAN node.
REMOTEPDOIN	To request data from a node in the form of a PDO message.
REMOTEPDOOUT	To force a Baldor controller node to transmit a variable length PDO message with a specific COB-ID. The PDO will contain up to 64 bits of data that can be passed in the form of two 32-bit values.
REMOTESTATUS	To set or read the status register on a remote CAN node.
RESETINPUT	To define the reset input for an axis.
SCALEFACTOR	To scale axis encoder counts, or steps, into user defined units.
SEXTANT	To read the current sextant value for a motor using Hall sensors.
SOFTLIMITFORWARD	To set the forward software limit position on a specified axis.
SOFTLIMITMODE	To set or read the default action taken if a forward or reverse software limit position is exceeded.
SOFTLIMITREVERSE	To set or read the reverse software limit position on a specified axis.
SPEED	To set or read the slew speed of positional moves loaded in the move buffer.
STOP	To perform a controlled stop during motion.
STOPINPUT	To set or read the digital input to be used as the stop switch input for the specified axis.
STOPMODE	To set or read the action taken when an axis is stopped.
STOPSWITCH	To return the current state of the stop input for the axis.
SUSPEND	To pause the current move.
SUSPENDINPUT	To set or read the digital input to be used as the suspend switch input for the specified axis.
SUSPENDSWITCH	To return the current state of the suspend input for the axis.
SYSTEMSECONDS	To set or read a programmable system lifetime counter for the drive.

Keyword	Description
TEMPERATURE	To report the internal drive temperature.
TEMPERATURELIMITFATAL	To set or read the temperature fatal limit.
TORQUEDEMAND	To return the instantaneous torque demand.
TORQUEFILTERBAND	Defines the band of operation for a torque filter stage.
TORQUEFILTERDEPTH	Defines the reduction in gain for a notch torque filter stage.
TORQUEFILTERFREQ	Defines a characteristic frequency for a torque filter stage.
TORQUEFILTERTYPE	Defines the type of characteristic used for the given torque filter stage.
TORQUELIMITNEG	To set or read the maximum negative torque limit.
TORQUELIMITPOS	To set or read the maximum positive torque limit.
TORQUEREF	To set or read a torque reference for torque (constant current) mode on a servo axis.
TORQUEREFERRORFALLTIME	To set or read the 'deceleration ramp' for a torque profile in the event of an error.
TORQUEREFFALLTIME	To set or read the 'deceleration ramp' for a torque profile.
TORQUEREFRISETIME	To set or read the 'acceleration ramp' for a torque profile.
VEL	To return the instantaneous axis velocity.
VELDEMAND	To read the current instantaneous demand velocity.
VELERROR	To report the velocity following error.
VELFATAL	To set or read the threshold for the maximum difference between demand and actual velocity.
VELFATALMODE	To control the default action taken in the event of the velocity threshold being exceeded.
VELREF	To set or read a fixed point speed reference.
VELSCALEFACTOR	To scale axis encoder counts, or steps, into user defined velocity units.
VELSCALEUNITS	To define a text description for the velocity scale factor.
VOLTAGEDEMAND	To read the voltage demand outputs from the current controllers.

D.1 Introduction

This section provides general information regarding recommended methods of installation for CE compliance. It is not intended as an exhaustive guide to good practice and wiring techniques. It is assumed that the installer of the MotiFlex *e*100 is sufficiently qualified to perform the task, and is aware of local regulations and requirements. Baldor products that meet the EMC directive requirements are indicated with a “CE” mark. A duly signed CE declaration of conformity is available from Baldor.



D.1.1 CE marking

The information contained herein is for your guidance only and does not guarantee that the installation will meet the requirements of the Electromagnetic Compatibility Directive 2004/108/EC or the Low Voltage Directive 2006/95/EC.

The purpose of the EEC directives is to state a minimum technical requirement common to all the member states within the European Union. In turn, these minimum technical requirements are intended to enhance the levels of safety both directly and indirectly.

Council directive 2004/108/EC relating to Electro Magnetic Compliance (EMC) indicates that it is the responsibility of the system integrator to ensure that the entire system complies with all relative directives at the time of installing into service.

Motors and controls are used as components of a system, per the EMC directive. Hence all components, installation of the components, interconnection between components, and shielding and grounding of the system as a whole determines EMC compliance.

The CE mark informs the purchaser that the equipment has been tested and complies with the appropriate standards. It rests upon the manufacturer or his authorized representative to ensure the item in question complies fully with all the relative directives in force at the time of installing into service, in the same way as the system integrator previously mentioned. Remember that it is the instructions of installation and the product that should comply with the directive.

D.1.2 Declaration of conformity

CE BALDOR BALDOR • DODGE • RELIANCE CE

Date: 21/01/08 **EC Declaration of Conformity** **Ref: DE00024-001**

Manufacturer: Baldor UK Limited
Address: Mint Motion Centre, 6 Bristol Distribution Park, Hawkley Drive, Bristol, BS32 0BF, United Kingdom

Hereby declare that the product:

MotiFlex *e*100 Single and Multi-Axis Servo Drive, being one of:

MFE460A0xxx (where *xxx* = product variant)

when used in accordance with the guidance given in the corresponding MotiFlex e100 Installation Manual (MN1943) conforms with the protection requirements of the following Council Directives, by application of the relevant harmonized standards:

The Electromagnetic Compatibility Directive 2004/108/EC and its amending directives:

Standard:	Title:
EN61800-3:2004	*Adjustable speed electrical power drive systems Part 3: EMC Requirements and specific test methods.*

The Low Voltage Directive 2006/95/EC and its amending directives:

Standard:	Title:
EN61800-5-1:2007	*Adjustable speed electrical power drive systems. Safety requirements. Electrical, thermal and energy.*
EN61800-2:1998	*Adjustable speed electrical power drive systems. General requirements. Rating specifications for low voltage adjustable frequency a.c. power drive systems*.
EN50178:1997	*Electronic equipment for use in power installations*.
EN60529:1991+A1	*Specification for degrees of protection provided by enclosures (IP code)*.

EC Declaration of Incorporation

The Machinery Directive 98/37/EC and its amending directives:

The above product is intended to be incorporated into machinery or to be assembled with other machinery to constitute machinery covered by directive 98/37/EC. As such it does therefore not in every respect comply with the provisions of directive 98/37/EC.

User must follow the guidance given in this directive to meet all necessary protection requirements. All instructions, warnings & safety information of the product manual MN1943 must be adhered to. User must follow the guidance given in harmonized standard EN60204-1 (Safety of Machinery) to meet necessary protection requirements of this directive.

Furthermore it is declared that it may not be put into service before the machinery in which it will be incorporated is declared to comply with the provisions of directive 98/37/EC, as amended.

Signed:

Dr. Gerry Boast
Engineering Manager

D.1.3 Use of CE compliant components

The following points should be considered:

- **Using CE approved components will not guarantee a CE compliant system!**
- The components used in the drive, installation methods used, materials selected for interconnection of components are important.
- The installation methods, interconnection materials, shielding, filtering and earthing / grounding of the system as a whole will determine CE compliance.
- The responsibility of CE mark compliance rests entirely with the party who offers the end system for sale (such as an OEM or system integrator).

D.1.4 EMC wiring technique

Cabinet
Using a typical electroplated zinc coated cabinet, connected to earth/ground, means that all parts mounted on the back plane are connected to earth/ground and all outer shield (screen) connections can be connected to earth/ground. Within the cabinet there should be a spatial separation between power wiring (motor and AC power cables) and control wiring.

Shield (screen) connections
All connections between components must use shielded cables. The cable shields must be connected to the cabinet. Use conductive clamps to ensure good earth/ground connection. With this technique, a good earth/ground shield can be achieved.

EMC filters
The filter should be mounted next to the MotiFlex *e*100. The connections between the MotiFlex *e*100 and the filter should use shielded (screened) cables. The cable shields should be connected to shield clamps at both ends.

Earthing/grounding
For safety reasons (VDE0160), all Baldor components must be connected to earth/ground with a separate wire. Earth/ground connections must be made from the central earth/ground (star point) to the regeneration resistor enclosure/case and from the central earth/ground (star point) to the power supply.

D.1.5 EMC installation suggestions

To ensure electromagnetic compatibility (EMC), the following installation points should be considered to help reduce interference:

- Earthing/grounding of all system elements to a central earth/ground point (star point)
- Shielding of all cables and signal wires
- Filtering of power lines.

A proper cabinet should have the following characteristics:

- All metal conducting parts of the cabinet must be electrically connected to the back plane. These connections should be made with an earthing/grounding strap from each element to a central earthing/grounding point (star point). *
- Keep the power wiring (motor and power cable) and control wiring separated. If these wires must cross, be sure they cross at 90 degrees to minimize noise due to induction.
- The shield connections of the signal and power cables should be connected to the shield rails or clamps. The shield rails or clamps should be conductive clamps fastened to the cabinet. **
- The cable to the regeneration resistor must be shielded. The shield must be connected to earth/ground at both ends.
- The location of the AC filter has to be situated close to the drive so the AC power wires are as short as possible.
- Wires inside the cabinet should be placed as close as possible to conducting metal, cabinet walls and plates. It is advised to terminate unused wires to chassis ground.*
- To reduce earth/ground current, use the largest suitable wire available for earth/ground connections.

* Earthing/grounding in general describes all metal parts which can be connected to a protective conductor, e.g. housing of cabinet, motor housing, etc. to a central earth/ground point (star point). This central earth/ground point (star point) is then connected to the main plant (or building) earth/ground.

** Or run as twisted pair at minimum.

D.1.6 Wiring of shielded (screened) cables

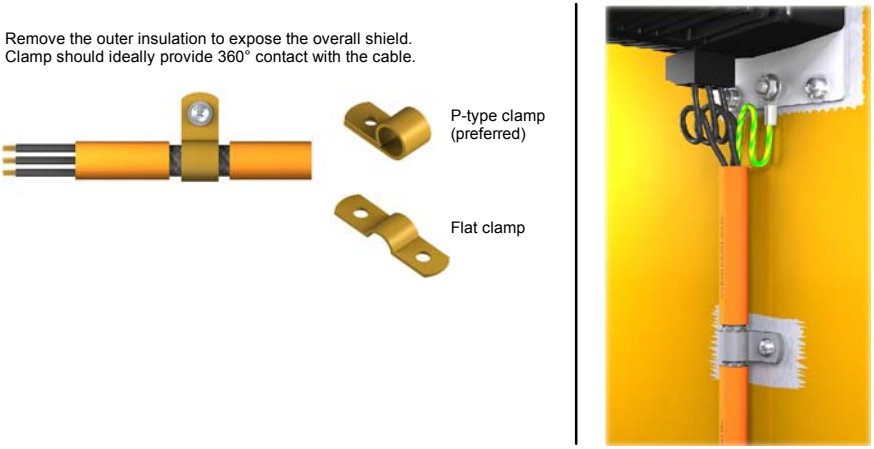

Remove the outer insulation to expose the overall shield.
Clamp should ideally provide 360° contact with the cable.
P-type clamp
(preferred)
Flat clamp

Figure 104 - Earthing/grounding cable shields

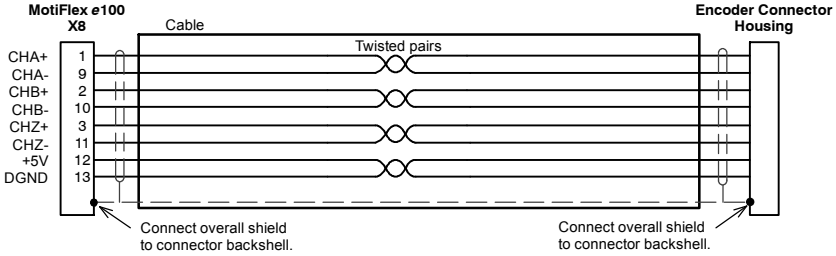


Figure 105 - Encoder signal cable grounding

D.2 UL file numbers

The following table lists UL file numbers for Baldor products and other accessories. Note that UL file numbers for accessories not manufactured by Baldor are beyond Baldor's control and therefore subject to change without notice.

UL file number	Company	Description
E128059	Baldor Electric Co.	Drives
E46145	Baldor Electric Co.	Motors
E212132	Renu Electronics PVT LTD	Programmable Controllers for Use in Hazardous Locations (Baldor keypad KPD202-501)
E132956	Cableswiss s.p.a.	Power cables (6A, 12A, 20A, 25A, 50A, 90A) Encoder cables Resolver/SSI cables EnDat cables
E192076	Unika Special Cables s.p.a	Power cables (6A, 12A, 20A, 25A, 50A, 90A) Encoder cables Resolver/SSI cables EnDat cables
E153698	Coninvers GmbH	Connectors
E64388	Schaffner EMV AG	AC filters
E70122	Epcos AG	AC filters
E212934	Frizlen GmbH & Co. KG	Regeneration (brake) resistors
E227820	RARA Electronics Corp.	Regeneration (brake) resistors

A

Abbreviations. *See* Units and Abbreviations
AC input current
  DC bus not shared, 8-2
  DC bus sharing, 8-4
AC input voltage, 8-1
AC line reactors, 3-19, 3-25, 8-4
  catalog numbers, A-4
Accessories, A-1
  AC line reactors, A-4
  AC supply (EMC) filters, A-3
  motor / power cable bracket, A-7
  motor power cables, A-9
  regeneration resistors, A-5
  signal cable bracket, A-8
Analog I/O, 5-2
  analog input (demand), 5-2
  analog input AIN0, 8-31

B

Basic Installation, 3-1
BiSS
  cable, 4-8
  interface, 4-7
  specification, 8-32
Busbars, 3-8, 3-23, A-2

C

CAN interface
  CANopen, 5-24
  connector, 5-22
  introduction, 5-22
  LEDs, 7-3
  opto-isolation, 5-23
  specifications, 8-33
  termination, 5-22
  wiring, 5-22
Catalog number, identifying, 2-2
CE Guidelines, D-1
  declaration of conformity, D-2
Circuit breakers, 8-2
Command window, 6-26
Commissioning Wizard, 6-12
  using, 6-13
Configuration, 6-24
Connections
  AC power, 3-14, 3-17
  feedback, 4-1
  motor, 3-28
Connectors
  CAN, 5-22
  Ethernet, 5-19, 5-21
  I/O, 5-5–5-14
  locations, bottom, 3-13
  locations, front, 3-11
  locations, top, 3-12
  RS485, 5-18
  USB, 5-17
Control system, B-1
  servo configuration, B-2
  torque servo configuration, B-4
Cooling
  intelligent fan control, 3-10
  overtemperature trips, 3-10
Crest factor
  1.5 A ~ 16 A models, 8-9
  21 A model, 8-12
  26 A & 33.5 A models, 8-13
  48 A & 65 A models, 8-14

D

DC bus sharing, 3-7, 3-8, 3-22, 3-23, A-2
  fuses & circuit breakers, 8-8
Demand input, 5-2
Derating. *See* Rating
Digital I/O, 5-4
  digital input DIN0, 5-7, 8-31
  digital inputs DIN1 & DIN2, 5-9, 8-31
  digital output DOUT0, 5-14, 8-32
  digital output DOUT1, 5-16, 8-32

drive enable input, 5-5, 8-31
fast position capture, 5-10
motor overtemperature input, 5-12
special functions on DIN1 & DIN2, 5-10
step & direction, 5-10
Dimensions, 3-4, 3-5, 3-6
Dynamic brake. *See* Regeneration resistor

E

Earthing (grounding)
leakage, 3-15, 3-16
protection class, 3-16
protective earth (PE), 3-14
Encoder, incremental
cable, 4-3, 4-5
interface, 4-2
specification, 8-32
without Halls, 4-4
EnDat
cable, 4-14
interface, 4-13
specification, 8-33
Environmental
location, 3-3–3-4
specification, 8-35
Ethernet interface
cables, A-10
connector, 5-21
ETHERNET Powerlink, 5-20
introduction, 5-19
LEDs, 7-4
specifications, 8-33
TCP/IP, 5-19

F

Fan control & loss detection, 3-10
Fast position capture, 5-10
Features, 2-1
Feedback
BiSS, 4-7
connections, 4-1
encoder without Halls, 4-4
EnDat, 4-13
Halls-only feedback, 4-4
incremental encoder, 4-2
SinCos, 4-11
SSI, 4-9
Filters
AC line reactors, 3-19, 3-25, A-4
AC supply (EMC), 3-20, A-3
catalog numbers, A-3
sinusoidal, 3-31
Fuses, 8-2

G

General Information, 1-1
Grounding. *See* Earthing (grounding)

H

Hardware requirements, 3-1
Help file, 6-9

I

Incremental encoder
cable, 4-3, 4-5
interface, 4-2
specification, 8-32
without Halls, 4-4
Indicators
CAN LEDs, 7-3
ETHERNET LEDs, 7-4
STATUS LED, 7-2
Input / Output, 5-1
analog input, 5-2
analog input AIN0, 8-31
CAN interface, 5-22
digital input DIN0, 5-7, 8-31
digital inputs DIN1 & DIN2, 5-9, 8-31
digital output DOUT0, 5-14, 8-32
digital output DOUT1, 5-16, 8-32
drive enable input, 5-5, 8-31
encoder interface, 4-1
Ethernet interface, 5-19
motor overtemperature input, 5-12
node ID selector switches, 5-25
RS485 interface, 5-18
USB interface, 5-17
Installation
See also Basic Installation
dimensions, 3-4, 3-5, 3-6
mechanical, 3-3

Mint Machine Center, 6-1
Mint WorkBench, 6-1
mounting, 3-7
TCP/IP configuration, 6-4
USB driver, 6-3

K

Keyword summary, C-1

L

LED indicators
CAN LEDs, 7-3
ETHERNET LEDs, 7-4
STATUS LED, 7-2
Line reactors, catalog numbers, A-4
Linear motor, cable configuration, 4-6

M

Mint keyword summary, C-1
Mint Machine Center (MMC), 6-5
starting, 6-7
Mint WorkBench, 6-8
Commissioning Wizard, 6-12
help file, 6-9
other tools and windows, 6-26
parameters tool, 6-24
spy window, 6-25
starting, 6-10
Motor
bottom panel wiring, 3-35
brake connections, 3-34
circuit contactor, 3-31
motor cable shielding, 3-30
output connections, 3-28
output specifications, 8-15–8-23
output uprating and derating, 8-17
overtemperature input, 3-35, 5-12
power cable, 3-32–3-33, A-9
sinusoidal filter, 3-31
Mounting, 3-7

N

Node ID selector switches, 5-25

O

Operation, 6-1
configuring the TCP/IP connection, 6-4
connecting to the PC, 6-1
installing Mint Machine Center, 6-1
installing Mint WorkBench, 6-1
installing the USB driver, 6-3
power on checks, 6-2
preliminary checks, 6-2
starting, 6-2
Overloads
drive, 3-18
motor, 3-28
overtemperature trips, 3-10
Overtemperature input, 3-35, 5-12

P

Parameters tool, 6-24
Power
18 V out / 24 V in control circuit supply, 3-26
reducing wiring, 3-27
AC line reactors, 3-19, 3-25, A-4
AC supply, 3-14, 3-17
discharge period, 3-21
disconnect and protection devices, 3-21
input conditioning, 3-19
input cycling, 3-18, 7-1
inrush current, 3-18
ready input, 3-24
ready output, 3-24
sources, 3-1
supply filters, 3-20, A-3
Power factor
1.5 A ~ 16 A models, 8-9
21 A model, 8-12
26 A & 33.5 A models, 8-13
48 A & 65 A models, 8-14
Precautions, 1-2
Product Notice, 1-2

R

Rating, AC input current
All models, DC bus not shared, 8-2

1.5 A model, DC bus sharing, 8-4
3 A model, DC bus sharing, 8-4
6 A model, DC bus sharing, 8-5
10.5 A model, DC bus sharing, 8-5
16 A model, DC bus sharing, 8-5
21 A model, DC bus sharing, 8-6
26 A model, DC bus sharing, 8-6
33.5 A model, DC bus sharing, 8-6
48 A model, DC bus sharing, 8-7
65 A model, DC bus sharing, 8-7
Rating, motor output current
1.5 A model, 8-17
3 A model, 8-18
6 A model, 8-19
10.5 A model, 8-20
16 A model, 8-21
21 A model, 8-22
26 A model, 8-23
33.5 A model, 8-24
48 A model, 8-25
65 A model, 8-26
Receiving and Inspection, 2-2
Regeneration
capacity, 3-37
duty cycle, 3-43
energy, 3-39
power, 3-39
resistor choice, 3-40
resistor, connection, 3-36
resistor, dimensions, A-5
resistor, duty cycle derating, 3-42
resistor, selection, 3-38
resistor, temperature derating, 3-41
specification, 8-27, 8-28
RS485
interface, 5-18
specifications, 8-34

S

Safety Notice, 1-2
SinCos
cable, 4-12
interface, 4-11
specification, 8-33
Specifications, 8-1
18 VDC output, 8-29
24 VDC backup supply, 8-29
AC input current, 8-2, 8-4
AC input voltage, 8-1
analog input AIN0, 8-31
BiSS interface, 8-32
CAN interface, 8-33
digital input DIN0, 8-31
digital input DIN1, 8-31
digital input DIN2, 8-31
digital output DOUT0, 8-32
digital output DOUT1, 8-32
drive enable input, 8-31
EnDat interface, 8-33
environmental, 8-35
ethernet interface, 8-33
incremental encoder interface, 8-32
motor output, 8-15, 8-16
1.5 A model, 8-17
3 A model, 8-18
6 A model, 8-19
10.5 A model, 8-20
16 A model, 8-21
21 A model, 8-22
26 A model, 8-23
33.5 A model, 8-24
48 A model, 8-25
65 A model, 8-26
uprating and derating, 8-17
regeneration, 8-27, 8-28
RS485 interface, 8-34
SinCos interface, 8-33
SSI interface, 8-32
weights and dimensions, 8-34
Spy window, 6-25
SSI
cable, 4-10
interface, 4-9
specification, 8-32
Standards, 2-4
Status LED, 7-2
Step & Direction
inputs DIN1/2, 5-10
specification, 8-31

T

TCP/IP, configuring, 6-4
Tools, 3-2
Troubleshooting, 7-1
  CAN LEDs, 7-3
  CANopen, 7-6
  communication, 7-5
  Ethernet, 7-6
  ETHERNET LEDs, 7-4
  Mint WorkBench, 7-5
  power cycling, 7-1
  power on, 7-5
  problem diagnosis, 7-1
  STATUS LED, 7-2
  SupportMe, 7-1
  tuning, 7-6
Tuning
  autotune wizard, 6-15
  load attached, 6-18
  no load attached, 6-16
  optimizing the velocity response, 6-19
  test moves, jog, 6-22
  test moves, positional, 6-23

U

UL file numbers, D-6
Units and abbreviations, 2-3
Uprating. *See* Rating
USB
  installing the driver, 6-3
  interface, 5-17

W

Weights and dimensions, 8-34
WorkBench. *See* Mint WorkBench

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